NUEXCO

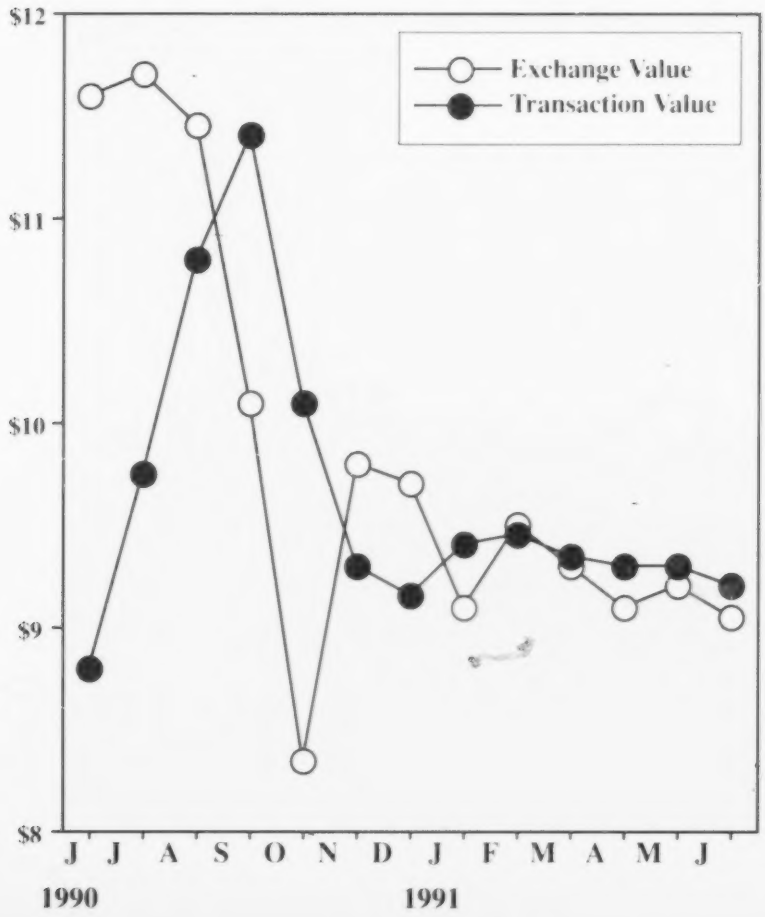
Monthly Report

July 1991 Number 275

The Uranium Industry of Bulgaria 20

The Present and Future of Nuclear Energy in the USSR 25

World Nuclear Plant Backlog 30



NUEXCO

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After 45 years of secrecy, details of the Bulgarian uranium industry are finally being released. In April, Thomas C. Pool visited several of Bulgaria's production centers, and describes in this article the industry's breadth and structure — and its problems.

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- **The Present and Future of Nuclear Energy and Industry in the USSR**

Mr. Vitaly F. Konovalov, Minister of the Soviet Union's Ministry of Atomic Energy and Industry, recently spoke in Tokyo to the JAIF about the nature of the Soviet Union's commercial nuclear industry.

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The world backlog contains 59 commercial nuclear reactors in 15 countries. This article describes the construction status for each country, and lists all the commercial nuclear units actively under construction.

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To Our Readers

NUEXCO is proud to report the 20-year service anniversary of George White Jr., who started his career with NUEXCO on July 6, 1971. George joined his father, a co-founder of NUEXCO, after working for Drexel Firestone, Inc. in New York where he was active in the bond market. George has been instrumental in NUEXCO's growth and has helped to establish its reputation in the marketplace. He is currently a Senior Vice-President of the company and is based in our San Francisco, California office. We congratulate George on his achievements.

* * *

CONCORD/NUEXCO is also pleased to announce that Mr. Ken C. Whyte has joined the International Advisory Committee (IAC). Mr. Whyte is well-known in business and financial circles, and is a knowedgeable authority on southern Africa. He is the director of several South African companies operating in the fields of prospecting, mining, trading, and finance. He is a Chartered Accountant and formerly a partner of Coopers & Lybrand. Mr. Whyte is also very active environmentally, owning and operating a large private game farm to promote the population of threatened species. CONCORD/NUEXCO is proud to welcome him to the IAC.

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Market Values Summary

NUEXCO Market Values	This Report June 30, 1991	Last Report May 31, 1991	12 Months Ago June 30, 1990
EXCHANGE VALUE[1]	**$9.05**/lb equivalent U_3O_8	$9.20	$11.60
UF_6 VALUE[2]	**$27.25**/kg U as UF_6	$27.60	$32.00
LOAN RATE[3]	**3.5%**/annum	3.5%	3.5%
CONVERSION VALUE[4]	**$1.50**/lb U as UF_6	$1.50	$1.45
SWU VALUE[5] **(0.3% tails assay)**	**$59**/SWU	$54	$50
TRANSACTION VALUE[6]	**$9.20**/lb equivalent U_3O_8	$9.30	$8.80
Transactions	**24**	21	38
Months	**3**	3	3
Millions of Pounds	**6.3**	5.3	11.3

DEFINITIONS

1 The **Exchange Value** is NUEXCO's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.

2 The **UF_6 Value** is NUEXCO's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.

3 The **Loan Value** is NUEXCO's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.

4 The **Conversion Value** is NUEXCO's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.

5 The **SWU Value** is NUEXCO's judgment of the price at which spot and near-term transactions for significant quantities of enrichment services could be concluded as of the date indicated.

6 The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:

a) Transactions closed within the previous three month period for which delivery is scheduled within one year of the transaction date;

b) At least ten transactions;

c) Transactions involving a sum total of at least 2 million pounds equivalent U_3O_8.

DERIVATIONS AND COMMENTS

- All **Market Values** are expressed in terms of US$.
- All **Market Values** are based on:
  - Data from recently completed transactions.
  - Data from pending transactions.
  - Firm bids to buy or borrow, and firm offers to sell or lend.
  - Prices purchasers or rates borrowers have expressed a willingness to pay, but for which NUEXCO is not aware of firm bids to buy or borrow and prices sellers or rates lenders have expressed a willingness to accept, but for which NUEXCO is not aware of firm offers to sell or lend.
- Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not included in the determination of these **Market Values**.
- In the determination of prices, NUEXCO does not consider charges for transportation other than that customarily provided by suppliers.
- The prices of services or materials delivered under long-term contracts with primary suppliers are not considered in the determination of the listed values.
- For the **SWU Value**, NUEXCO converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight percent U^{235} and a product assay of 3.0 weight-percent U^{235}, assuming feed costs corresponding to the NUEXCO **Exchange Value** and **Conversion Value** determined as of the same date.
- In calculating the **Transaction Value**, NUEXCO does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future **Exchange Values** or any other indeterminate variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it can not currently be determined.
- The sample time for the **Transaction Value** is extended as necessary to satisfy the minima for the number of transactions and quantity of material. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

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MARKET REVIEW

JUNE MARKET REVIEW

(as of June 30, 1991)

OVERVIEW

The uranium market softened during June, as reflected by the June 30, 1991 Exchange Value, which dipped $0.15, to $9.05 per pound U_3O_8. Following the concentrates market, the UF_6 Value also declined, dropping $0.35, to $27.25 per kgU as UF_6. Ten uranium sales were reported totalling 2.3 million pounds equivalent U_3O_8. Nine sales involved concentrates, and one involved natural UF_6. No enriched uranium product (EUP) sales were reported during June.

Each of the separate sections of this market review will present information about the year-to-date transactions. As of the end of the first half of the year, 57 near-term uranium sales have been reported for a total of 13.5 million pounds equivalent U_3O_8 (**Table 1**). These year-to-date figures reflect all near-term uranium transactions of which NUEXCO is aware, including some transactions that have not been reported previously due to confidentiality concerns or lack of information at the time of the transaction. The 1991 level of 57 sales for a total of 13.5 million pounds is the second highest in uranium spot market history, but lags significantly behind the record uranium sales and volume of the first half of 1990 that totalled 69 transactions and 22.7 million pounds equivalent U_3O_8. Market uncertainty, more cautious buyers and sellers, and lower demand, both actual and discretionary, have all contributed to this year's lower market volume.

Table 1
NEAR-TERM URANIUM SALES SUMMARY

	June 1991		Year-to-Date	
	No. of Sales	Volume[1]	No. of Sales	Volume[1]
Concentrates	9	2.3	37	7.9
Natural UF_6	1	<0.1	13	4.3
EUP	0	0.0	7	1.3
Total[2]	**10**	**2.3**	**57**	**13.5**

[1] Million pounds equivalent U_3O_8
[2] Due to independent rounding, columns may not equal total.

The June 30 Loan Rate and Conversion Value both were unchanged, at 3.5 percent per annum and $1.50 per pound U as UF_6, respectively. Two loans totalling over 1.5 million pounds equivalent U_3O_8 were reported, but there were no conversion transactions in June.

The enrichment market strengthened during June as inventories declined further and the pace of activity continued to increase. The SWU Value increased a record five dollars, to $59 per SWU. Two near-term enrichment sales were reported totalling nearly 700 thousand SWU.

NATURAL URANIUM AND CONVERSION

The **Exchange Value** slid $0.15 (1.6%), to **$9.05** per pound U_3O_8 on June 30, 1991. Increased supply and limited demand, much of it discretionary, contributed to the market weakness. Buyers entering the market were met by determined sellers, and nine concentrates sales totalling 2.3 million pounds U_3O_8 were concluded.

Of the nine June concentrates sales, nearly all involved US sellers, and six of the nine buyers were US. A fairly even mix of utilities, intermediaries, and producers made the purchases, mostly from intermediary sellers. Eight of the nine deals occurred at price levels at or near the June 30 Exchange Value.

To date this year, 37 transactions have involved concentrates for a total of nearly eight million pounds, accounting for 58 percent of uranium market volume. Twenty-eight purchases for over 5.3 million pounds have been made by US entities. European, Australian, and Asian customers make up the balance. Buying has been fairly equally split between intermediaries, producers, and utilities, both in terms of volume and number of purchases.

The majority of concentrates sales have been concluded by intermediaries, accounting for 20 sales and 4.8 million pounds. Producers are next, with nine sales for over two million pounds. Most of the sellers have been from the USA, with 21 sales totalling 4.5 million pounds equivalent U_3O_8 in the form of concentrates.

* * *

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The June **UF_6 Value** declined $0.35 (1.3%), to **$27.25** per kgU as UF_6, as the UF_6 market reflected the weakening in the concentrates market. Only one UF_6 transaction was reported; a US utility purchased a small quantity at a price near the June 30 UF_6 Value.

Thirteen near-term uranium hexafluoride transactions have been concluded through the first half of the year, for a total of nearly 4.3 million pounds equivalent U_3O_8. Utilities have made nine of the purchases involving a total of 3.9 million pounds; intermediaries purchased the balance. The UF_6 volume has been almost equally split between European and US buyers, although US buyers made a higher number of purchases, but for lower average volume.

Intermediaries were the primary UF_6 sellers, supplying 3.9 million pounds in 11 of the 13 sales. US entities have accounted for 10 sales and 3.5 million pounds, while European entities made up the balance.

* * *

In the long-term market in June, three sales involving concentrates were reported. A utility purchased a total of almost two million pounds from three different intermediaries for delivery during the period 1994-1996.

Year-to-date, there have been 19 long-term natural uranium sales totalling almost 19 million pounds equivalent U_3O_8. All but two of the buyers were utilities; the others were an intermediary and a producer. Delivery schedules range from 1991 through 1998.

* * *

The **Transaction Value** decreased by $0.10, to **$9.20** per pound U_3O_8 based on 24 transactions over 3 months involving 6.3 million pounds equivalent U_3O_8.

* * *

Active uranium supply jumped by over four million pounds, to **11.2** million pounds equivalent U_3O_8. This increased supply was a major factor in June's softening uranium market. **Active uranium demand** also increased, edging up 295 thousand pounds, to **1.7** million pounds equivalent U_3O_8. The **supply/demand ratio** increased to **6.6** (**Table 2**).

The **Loan Rate** remained unchanged at **3.5** percent per annum. Two loans were reported during June: US entities borrowed a total of over 1.5 million pounds equivalent U_3O_8. In each case, the interest rate paid for the loans could be evaluated at a level near the June 30 Loan Rate.

A total of 5.8 million pounds equivalent U_3O_8 has been borrowed in nine natural uranium loans so far this year. Eight of the nine loans have had US borrowers; lenders have been from the USA, Europe, and Asia.

* * *

After rising slightly in May, the **Conversion Value** was unchanged on June 30, remaining at **$1.50** per pound U as UF_6. No conversion transactions were reported. Through the first half of 1991, there have been four long-term conversion sales totalling over 4.5 million pounds U for delivery during the period 1991-1997. There have also been five near-term sales for over 800 thousand pounds U as UF_6. Of the near-term transactions, four buyers and four sellers have been from the USA. The sellers have consisted of four intermediaries and a converter, while near-term buyers have included two utilities and three intermediaries.

Table 2
NEAR-TERM SUPPLY/DEMAND SUMMARY

	Active Supply[1]	Active Demand[1]
• Uranium (thousand lbs equivalent U_3O_8)	11,180	1,695
• Supply/Demand Ratio:	6.6	
• Loan (thousand lbs equivalent U_3O_8)	4,530	0
• Conversion (thousand lbs U as UF_6)	700	0
• SWU (thousand SWUs)	380	310

[1] Supply and Demand tables in the Market Review section of this Report provide details for each category.

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ENRICHMENT SERVICES AND ENRICHED URANIUM PRODUCT

Activity in the enrichment market continued to increase as the market strengthened throughout the month. The **SWU Value** rose five dollars, to **$59** per SWU. This is the largest single increase in the history of the NUEXCO SWU Value, which was first published on January 31, 1986. Two near-term SWU sales were concluded in late May and early June, involving a total of nearly 700 thousand SWU. The dwindling availability of low-priced SWU, combined with discretionary demand derived from long-term requirements, has caused the firming in the spot market.

Activity in the long-term SWU market remains intense. As many as 15 utilities, mostly from the USA, were evaluating enrichment supply alternatives during June. The current level of long-term prices has led many utilities to consider a number of supply options, including buy-and-hold strategies. With many utilities still evaluating alternatives at month-end, July could be a very active month in the enrichment market.

Through June 1991, there have been 18 near-term enrichment transactions totalling over 1.5 million SWU. Eight of the transactions have involved SWU contained in EUP. Of the 18 buyers, fourteen have been utilities; eleven US and three European. The other buyers include fabricators, enrichers, and intermediaries. Enrichment sellers also have been varied, with intermediaries, utilities, enrichers, and fabricators all having sold enrichment services so far this year. Despite all the recent long-term enrichment market activity, only one long-term SWU sale has been reported so far this year: a US utility purchased a moderate quantity of SWU from an intermediary for delivery during 1992-1995.

Table 3
ENRICHMENT PRICES
(June 30, 1991)

Prices	This Month Report 275	Last Month Report 274	12 Months Ago Report 263
NUEXCO SWU Value ($US per SWU)	59	54	50
US DOE SWU prices: ($US per SWU)			
USEC	117.85[1]	117.85[1]	117.85[1]
AFC	153.00[2]	153.00[2]	153.00[2]
Requirements	157.00[2]	157.00[2]	157.00[2]
Incentive Price (IP2)[3]	100.68[3,6]	100.60[3,6]	90.00[4]
Calculated worth of enriched UF_6[5]: ($US per KgU as UF_6)			
2.0 w/o U^{235}	212	205	223
2.5 w/o U^{235}	294	284	306
3.0 w/o U^{235}	379	365	391
3.5 w/o U^{235}	466	447	478
4.0 w/o U^{235}	554	531	565
4.5 w/o U^{235}	643	616	654

[1] Effective 10/1/89 to 9/30/91.
[2] Effective since 10/1/84.
[3] IP2: Effective 10/1/90 to 9/30/91, for up to 30% of annual requirements.
[4] Used Incentive Price IP1 – effective 10/1/86 to 9/30/90, for up to 30% of annual requirements.
[5] Calculated using the NUEXCO Exchange Value, Conversion Value, SWU Value and 0.30 w/o U^{235} tails assay.
[6] IP2 price of $100.60 was a provisional price; after updates to GNPIPD values, the final IP2 price was determined.

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RECENT TRANSACTIONS

Uranium Sales[1]

NUEXCO Transaction Number	Delivery Period	Approximate Quantity (thousand pounds equivalent U_3O_8)	Price Within Percentage Range[2] of Current Exchange or UF_6 Value	Buyer	Seller	Remarks
5128	1991	Less than 50	98-102	Utility	Intermediary	UF_6
5129	1991	101-300	98-102	Utility	Intermediary	
5130	1991	Less than 50	98-102	Utility	Producer	
5133	1991	101-300	98-102	Utility	Intermediary	
5135	1991	101-300	98-102	Intermediary	Intermediary	
5137	1991	601-1,000	98-102	Producer	Intermediary	
5138	1991	Less than 50	98-102	Intermediary	Producer	
5140	1995	601-1,000	R	Utility	Intermediary	
5141	1996	601-1,000	R	Utility	Intermediary	
5142	1994	601-1,000	R	Utility	Intermediary	
5143	1991	R	103-110	Intermediary	Intermediary	
5148	1991	101-300	98-102	Intermediary	R	
5150	1991	Less than 50	98-102	Producer	Intermediary	

R means that NUEXCO either does not know, or that NUEXCO has restricted that information to protect client or source confidentiality.

[1] Transactions listed are not limited to those in which NUEXCO was involved, but also include others of which NUEXCO is aware. NUEXCO may delay reporting some transactions in order to protect proprietary information.

[2] The ranges *Below 90, 90-97, 98-102, 103-110, Above 110*, represent percentages (rounded to whole numbers) of the appropriate current Exchange Value or UF_6 Value. The endpoints of each range are included within that range.

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MARKET REVIEW

RECENT TRANSACTIONS

Natural Uranium Loans [1]

NUEXCO Transaction Number	Delivery Period	Approximate Quantity (thousand pounds equivalent U_3O_8)	Price Within Percentage Range [2] of Current Loan Rate	Borrower	Lender	Remarks
5136	1991	601-1,000	Above 110	Intermediary	R	
5147	1991	301-600	Below 90	Intermediary	Intermediary	

Conversion Sales [1]

NUEXCO Transaction Number	Delivery Period	Approximate Quantity (thousand pounds of U equivalent)	Price Within Percentage Range [2] of Current – Conversion Value	Buyer	Seller	Remarks

No Conversion Sales are reported

Enrichment Sales [1]

NUEXCO Transaction Number	Delivery Period	Approximate Quantity [3] (thousand SWU)	Price Within Percentage Range [2] of Current SWU Value [4]	Buyer	Seller	Remarks
5146	1991	301-600	90-97	R	Utility	
5149	1992	301-600	90-97	R	Utility	

R means that NUEXCO either does not know, or that NUEXCO has restricted that information to protect client or source confidentiality.

[1] Transactions listed are not limited to those in which NUEXCO was involved, but also include others of which NUEXCO is aware. NUEXCO may delay reporting some transactions in order to protect proprietary information.

[2] The ranges *Below 90, 90-97, 98-102, 103-110, Above 110*, represent percentages (rounded to whole numbers) of the appropriate current Market Value. The endpoints of each range are included within that range.

[3] If tails assay is unknown or unspecified, NUEXCO's calculation of SWU quantity assumes 0.30 w/o tails assay.

[4] Prices are usually normalized to 0.30 w/o tails assay. When prices and SWU values are expressed as discounts from a reference price (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage price range is based on the discounted prices, not on the reference price.

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SUPPLY AND DEMAND

Uranium Supply

NUEXCO Project Number	Quantity (Thousand Pounds equivalent U_3O_8) Spot or Near-term [1]	Intermediate or Long-term [2]	Delivery Period	Remarks
AVAILABLE FOR SALE:				
ACTIVE				
89-1054A*	3,430	—	1991 on	UF_6e
90-1078A	700	1,045 per year	1991-1993	UF_6e
90-1227	500	—	1991	
90-1231	500	500 per year	1991-1995	
90-1501	3,000	1,000 per year	1991-95	U_3O_8/UF_6
91-1060	100	—	1991	
91-1145*	520	—	1991	
91-1157*	100	—	1991	
91-1502	500	—	1991	
91-1503A	1,330	2,670	1991-1993	UF_6e
91-1505	500	—	1991	
TOTAL	**11,180**			
INACTIVE	**2,600**			
AVAILABLE FOR LOAN:				
ACTIVE				
91-1084	3,900	—	—	U_3O_8
91-1132*	100	—	—	U_3O_8
91-1146*	140	—	—	UF_6
91-1151*	390	—	—	U_3O_8
TOTAL	**4,530**			
INACTIVE	**655**			

*New or revised since last month.

[1] For delivery within one year, measured from the date of this Report. This category excludes material deliverable within one year under other than spot or near-term contracts.

[2] For delivery beyond one year, measured from the date of this Report.

Active Projects reclassified as Inactive since last month: *none*
Active Projects removed since last month: 90-1230, 91-1034

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MARKET REVIEW

SUPPLY AND DEMAND

Uranium Demand

NUEXCO Project Number	Quantity (Thousand Pounds equivalent U_3O_8) Spot or Near-term [1]	Intermediate or Long-term [2]	Delivery Period	Remarks
INQUIRIES TO PURCHASE:				
ACTIVE				
90-1224A*	235	11,700	1991-2001	U_3O_8/UF_6/UF_6e
90-1304*	20	20 per year	1991-1994	
91-1010A	85	—	1991	UF_6e
91-1106	405	—	1991	
91-1112	160	—	1991-1992	U_3O_8/UF_6
91-1127A	390	—	1992	UF_6e
91-1138*	150	—	1991	U_3O_8/UF_6
91-1158*	250	—	1991	
90-1291	—	100 per year	1991-1995	
91-1014A	—	6,800	1992-2001	UF_6e
91-1017	—	300 per year	1995-2000	
91-1064*	—	460 per year	1993-1997	U_3O_8/UF_6
91-1094A	—	1,700 per year	1994-1995	UF_6e
91-1102	—	1,000 per year	1992-1995	U_3O_8/UF_6
91-1108	—	400 per year	1993-1997	U_3O_8/UF_6
91-1110	—	90	1992	UF_6
91-1118	—	300 per year	1993-1998	U_3O_8/UF_6
91-1141*	—	500	1994	
TOTAL	**1,695**			
INACTIVE	**545**			

INQUIRIES TO BORROW: *No inquiries to borrow are reported*

* New or revised since last month.

[1] For delivery within one year, measured from the date of this Report. This category excludes material deliverable within one year under other than spot or near-term contracts.

[2] For delivery beyond one year, measured from the date of this Report.

Active Projects reclassified as Inactive since last month: 90-1100A
Active Projects removed since last month: 91-1054, 91-1093, 91-1115, 91-1122

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SUPPLY AND DEMAND

Conversion Supply And Demand

NUEXCO Project Number	Quantity (Thousand Pounds U as UF6) Within 3 Years [1]	Beyond 3 Years [1]	Delivery Period	Remarks
AVAILABLE FOR SALE:				
ACTIVE				
91-1500	300	—	1991	
91-1501	400	—	1991	
Total	**700**			
INACTIVE	*None reported*			
INQUIRIES TO PURCHASE:				
ACTIVE				
91-1103*	0	12,350	1993-1995	
Total	**0**			
INACTIVE	*None reported*			

* New or revised since last month.

[1] Measured from the date of this Report.

Active Projects reclassified as Inactive since last month: *none*
Active Projects removed since last month: *none*

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MARKET REVIEW

SUPPLY AND DEMAND

SWU Supply And Demand

NUEXCO Project Number	Quantity (Thousand SWUs) Spot or Near-term [1]	Intermediate or Long-term [2]	Delivery Period	Remarks
AVAILABLE FOR SALE:				
ACTIVE				
90-1078B	200	435 per year	1991-1993	UF6e
91-1008	130	—	1991	
91-1032	50	—	1991	
90-1500	—	1,000	1991 on	
TOTAL	**380**			
INACTIVE	**1,685**			
INQUIRIES TO PURCHASE:				
ACTIVE				
91-1010B	20	—	1991	UF6e
91-1127B	90	—	1992	UF6e
91-1128	50	—	1991	
91-1150*	150	—	1991	
90-1144*	—	240	1995-2000	
90-1181	—	1,500	1996-2001	
90-1196	—	60 per year	1995 on	
90-1224B	—	1,920	1991-2001	UF6e
90-1301	—	1,000 per year	1995-2000	UF6e
91-1014B	—	1,770	1992-2001	UF6e
91-1027	—	55 per year	1996-2000	
91-1063	—	15 per year	1995-1998	
91-1066	—	320	1995-2000	
91-1083	—	150 per year	1996-1998	
91-1094B	—	385 per year	1994-1995	UF6e
91-1105	—	205	1996-2001	
91-1109	—	150 per year	1992-1996	
91-1113	—	710	1996-2000	
91-1120	—	120	1996-1999	
91-1121	—	50	1996-1998	
91-1131*	—	3,660	1995-2001	
91-1136*	—	120	1996-2000	
91-1142*	—	75 per year	1995-2000	
91-1152*	—	2,700	1995-2001	
91-1154*	—	285	1996-2001	
91-1155*	—	1,064	1996-1999	
91-1156*	—	300	1992	
TOTAL	**310**			
INACTIVE	**195**			

* New or revised since last month.

[1] For delivery within one year, measured from the date of this Report. This category excludes SWU deliverable within one year under other than spot or near-term contracts.

[2] For delivery beyond one year, measured from the date of this Report.

Active Projects reclassified as Inactive since last month: 90-1100B

Active Projects removed since last month: *none*

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MARKET VALUES EXPRESSED IN SELECTED CURRENCIES

Exchange Value[1]

Country (currency)	per lb equivalent U_3O_8 as Concentrates			per kg U as Concentrates		
	This Month (June 30, 1991)	Last Month (May 31, 1991)	12 Months Ago (June 30, 1990)	This Month (June 30, 1991)	Last Month (May 31, 1991)	12 Months Ago (June 30, 1990)
Australia (dollar)	11.81	12.09	14.74	30.70	31.43	38.32
Belgium (franc)	337.31	329.63	398.63	876.93	856.97	1,036
Canada (dollar)	10.33	10.53	13.56	26.87	27.38	35.24
EC (ecu)	7.98	7.72	9.38	20.75	20.06	24.39
Finland (markka)	38.81	38.11	45.58	100.90	99.07	118.49
France (franc)	55.55	54.40	65.14	144.41	141.43	169.35
Germany (mark)	16.39	16.03	19.39	42.62	41.66	50.42
Italy (lira)	12,182	11,891	14,233	31,670	30,914	37,003
Japan (yen)	1,246	1,272	1,755	3,239	3,307	4,614
Netherlands (guilder)	18.47	18.06	21.83	48.02	46.96	56.76
So. Africa (comm. rand)	26.13	25.92	30.79	67.92	67.37	80.06
So. Korea (won)	6,555	6,664	8,201	17,042	17,326	21,320
Spain (peseta)	1,028	992.23	1,191	2,672	2,580	3,097
Sweden (krona)	59.19	57.46	70.22	153.88	149.39	182.55
Switzerland (franc)	14.06	13.65	16.48	36.55	35.48	42.84
Taiwan (dollar)	242.81	247.48	313.44	631.25	643.39	814.87
UK (pound)	5.57	5.42	6.67	14.49	14.09	17.35
US (dollar)	9.05	9.20	11.60	23.53	23.92	30.16

Transaction Value[1]

Country (currency)	per lb equivalent U_3O_8 as Concentrates			per kg U as Concentrates		
	This Month (June 30, 1991)	Last Month (May 31, 1991)	12 Months Ago (June 30, 1990)	This Month (June 30, 1991)	Last Month (May 31, 1991)	12 Months Ago (June 30, 199)
Australia (dollar)	12.00	12.22	11.18	31.20	31.77	29.07
Belgium (franc)	342.90	333.21	302.41	891.46	866.28	786.19
Canada (dollar)	10.51	10.64	10.28	27.31	27.67	26.74
EC (ecu)	8.12	7.80	7.12	21.10	20.28	18.51
Finland (markka)	39.45	38.52	34.57	102.57	100.14	89.89
France (franc)	56.47	54.99	49.42	146.80	142.96	128.47
Germany (mark)	16.67	16.20	14.71	43.33	42.11	38.25
Italy (lira)	12,384	12,020	10,798	32,195	31,250	28,071
Japan (yen)	1,266	1,286	1,346	3,292	3,343	3,500
Netherlands (guilder)	18.78	18.26	16.56	48.81	47.47	43.06
So. Africa (comm. rand)	26.56	26.20	23.36	69.05	68.11	60.73
So. Korea (won)	6,664	6,737	6,221	17,324	17,514	16,174
Spain (peseta)	1,045	1,003	903.77	2,716	2,608	2,350
Sweden (krona)	60.17	58.09	53.27	156.43	151.02	138.49
Switzerland (franc)	14.29	13.80	12.50	37.16	35.87	32.50
Taiwan (dollar)	246.83	250.17	237.78	641.71	650.38	618.18
UK (pound)	5.67	5.48	5.06	14.73	14.24	13.16
US (dollar)	9.20	9.30	8.80	23.92	24.18	22.88

[1] As of May 1991 Report #273; calculated using currency exchange rates for the last business day of the month, as published in *The Wall Street Journal*. Prior to May 1991 Report #273; calculated using currency exchange rates published in *The Wall Street Journal* on the last business day of the month.

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MARKET REVIEW

MARKET VALUES EXPRESSED IN SELECTED CURRENCIES

Conversion Value[1]

Country (currency)	per lb U as UF_6			per kg U as UF_6		
	This Month (June 30, 1991)	Last Month (May 31, 1991)	12 Months Ago (June 30, 1990)	This Month (June 30, 1991)	Last Month (May 31, 1991)	12 Months Ago (June 30, 1990)
Australia (dollar)	1.96	1.97	1.84	4.31	4.35	4.06
Belgium (franc)	55.91	53.74	49.83	123.26	118.49	109.85
Canada (dollar)	1.71	1.72	1.69	3.78	3.78	3.74
EC (ecu)	1.32	1.26	1.17	2.92	2.77	2.59
Finland (markka)	6.43	6.21	5.70	14.18	13.70	12.56
France (franc)	9.21	8.87	8.14	20.30	19.55	17.95
Germany (mark)	2.72	2.61	2.42	5.99	5.76	5.34
Italy (lira)	2,019	1,939	1,779	4,451	4,274	3,922
Japan (yen)	206.47	207.38	221.85	455.19	457.20	489.09
Netherlands (guilder)	3.06	2.95	2.73	6.75	6.49	6.02
So. Africa (comm. rand)	4.33	4.23	3.85	9.55	9.32	8.49
So. Korea (won)	1,086	1,087	1,025	2,395	2,395	2,260
Spain (peseta)	170.32	161.78	148.92	375.49	356.66	328.30
Sweden (krona)	9.81	9.37	8.78	21.63	20.66	19.35
Switzerland (franc)	2.33	2.23	2.06	5.14	4.91	4.54
Taiwan (dollar)	40.24	40.35	39.18	88.72	88.96	86.38
UK (pound)	0.92	0.88	0.83	2.04	1.95	1.84
US (dollar)	1.50	1.50	1.45	3.31	3.31	3.20

SWU Value And UF_6 Value[1]

Country (currency)	SWU Value at 0.30 w/o Tails Assay			UF_6 Value per kg U as UF_6		
	This Month (June 30, 1991)	Last Month (May 31, 1991)	12 Months Ago (June 30, 1990)	This Month (June 30, 1991)	Last Month (May 31, 1991)	12 Months Ago (June 30, 1990)
Australia (dollar)	76.97	70.96	63.54	35.55	36.27	40.67
Belgium (franc)	2,199	1,935	1,718	1,016	988.89	1,100
Canada (dollar)	67.37	61.81	58.43	31.12	31.59	37.40
EC (ecu)	52.04	45.28	40.44	24.04	23.15	25.88
Finland (markka)	253.02	223.49	196.45	116.86	114.32	125.73
France (franc)	362.12	319.30	280.77	167.25	163.20	179.69
Germany (mark)	106.88	94.06	83.60	49.37	48.08	53.50
Italy (lira)	79,419	69,794	61,350	36,681	35,673	39,264
Japan (yen)	8,121	7,466	7,650	3,751	3,816	4,896
Netherlands (guilder)	120.41	106.03	94.11	55.61	54.19	60.23
So. Africa (comm. rand)	170.32	152.11	132.73	78.67	77.75	84.95
So. Korea (won)	42,735	39,116	35,348	19,738	19,993	22,623
Spain (peseta)	6,699	5,824	5,135	3,094	2,977	3,286
Sweden (krona)	385.87	337.29	302.66	178.22	172.39	193.70
Switzerland (franc)	91.66	80.11	71.02	42.33	40.94	45.45
Taiwan (dollar)	1,583	1,453	1,351	731.11	742.43	864.65
UK (pound)	36.33	31.80	28.76	16.78	16.25	18.41
US (dollar)	59.00	54.00	50.00	27.25	27.60	32.00

[1] As of May 1991 Report #273; calculated using currency exchange rates for the last business day of the month, as published in *The Wall Street Journal*. Prior to May 1991 Report #273; calculated using currency exchange rates published in *The Wall Street Journal* on the last business day of the month.

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RECENT DEVELOPMENTS

Australia

In something of a surprise during its biennial conference in late June, the Australian Labor Party (ALP), ignored the recommendations of its own uranium policy review committee and voted to block any current expansion of Australia's uranium industry. Until recently it had been assumed, based on the review committee's findings and support for expansion expressed from such party luminaries as Prime Minister Bob Hawke and Treasurer John Kerin (formerly Minister of Primary Industries and Energy), that the restrictive three-mines policy would be effectively eliminated. Despite promising to speak in favor of such a change, Prime Minister Hawke did not participate in the debate, causing political observers to speculate that his silence on this issue was payment to the Left for their support during the recent leadership challenge mounted by Mr. Keating.

The practical effect of maintaining the current uranium policy is to defer, still further, the predeployment and premarketing efforts of such potential new mines as Denison's Koongarra in the Northern Territory, and CRA's Kintyre in Western Australia.

The situation regarding Pancontinental's Jabiluka deposit changed with the early July announcement that North Broken Hill Peko, the 65-percent owner of ERA, had purchased the Jabiluka deposit for A$125 million. Pancontinental will sell 100 percent of Jabiluka after exercising a 1987 option to acquire Texaco's 35-percent share for A$30 million. The transaction, which has been in negotiation for more than six months, will almost certainly result in the eventual processing of Jabiluka ore (estimated to contain more than 450 million pounds equivalentU_3O_8) at ERA's nearby Ranger mill. Although development of the ore body is not expected in the near future, this transaction clearly sets the stage for mining Jabiluka, even if the government's current uranium policy remains unchanged. This transaction also highlights the continuing consolidation of the uranium industry worldwide.

The ALP's decision to block any liberalization of its uranium policy at this time is unlikely to have any near-term commercial impact. The same, unfortunately, cannot be said about the longer term, for this action will once again focus buyers' attention on the continuing potential for government interference in Australia's uranium supply industry—raising politics as a security-of-supply issue.

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RECENT DEVELOPMENTS

USCEA

The International Enrichment Conference sponsored by the US Council for Energy Awareness was held in Washington DC, on June 23-26, 1991. The conference was well attended by industry participants and provided a focal point for the discussion of issues involving uranium enrichment activities in the world today. Papers were presented on topics such as the outlook for uranium enrichment, regulation and the environment, and the status of advanced technology development. In addition, panel discussions focused on the post-1995 market, and the restructuring of the Department of Energy's (DOE) Uranium Enrichment Enterprise. Highlights of some of the papers and discussions are presented below.

Uranium Enrichment Future: DOE's Perspective

Mr. William Young, DOE Assistant Secretary for Nuclear Energy, discussed the National Energy Strategy (NES) and emphasized nuclear energy's role as part of a balanced array of power sources necessary for meeting US energy needs. According to the NES, there is a need for US nuclear generating capacity to increase by 190 to 275 GWe by the year 2010, and to double by the year 2030 to meet projected energy demands. In order to meet these objectives, the first order for a nuclear plant should be placed by 1995, and the plant should be ready for operation by the year 2000. Mr. Young also discussed the uranium enrichment program and the commitment by DOE to be the foremost supplier of enrichment services in the Western World. He emphasized that a strong DOE sales base would allow DOE to maintain efficient diffusion plant operations and to continue the AVLIS (Atomic Vapor Laser Isotope Separation) deployment process. Mr. Young indicated that test data from AVLIS assures DOE that the cost for AVLIS will be 50-percent lower than the cost from other enrichment technologies.

Uranium Enrichment—A Look Ahead

A brief history of US government actions and policies toward uranium enrichment and non-proliferation was presented by Richard Kennedy, Ambassador-at-Large, US Department of State. According to Mr. Kennedy, the government's closing of the enrichment order books to new contracts during the mid-1970s was a major factor in creating the present market. This action prompted the creation of new foreign enrichment supply capacity and diminished the US government's image as a reliable source of enrichment supply. Since that time, the question of reliability has transformed the US government from a position of sole supplier of enrichment services, to a position of having about a 40-percent share of the world market. Regardless of whether the US nuclear program grows in the future, there will be a greater number of nuclear reactors in the world and the need for enrichment services will grow as well. Congress, therefore, must restructure DOE and reestablish it as a reliable supplier, thereby improving the government's influence in non-proliferation efforts.

Uranium Enrichment: A Success Today, An Asset for Tomorrow

Mr. Jean-Yves Barre, of Commissariat à l'Énergie Atomique (CEA) of France, discussed the future of uranium enrichment. He believes the prevailing buyers' market will continue until at least the year 2000. Contrasting with what looks like widely fluctuating enrichment policies in the USA, he believes that the scene in Europe shows good stability and a clear long-term view, with plans calling for Eurodif to remain in normal operation for at least 20 years. He observed that the development of advanced enrichment processes can then be carried out without haste, at a pace coherent with technological progress and adapted to forecasts on market demand. Following such a path would indicate that new capacities probably will need to come on line by the 2005 to 2010 timeframe.

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Regulation and the Environment: A Cogema Perspective

Mr. Arnaud de Bourayne of Cogema provided an interesting perspective to the solution of tails material buildup at the Eurodif gaseous diffusion plant. Presently Eurodif has 150,000 metric tons of depleted U as UF_6 produced since 1978. Since indefinite storage is not permitted at the plant site and no more than 50,000 metric tons is allowed to be stored, Cogema has constructed a defluorination facility and has begun to convert the tails material from UF_6 to U_3O_8. The facility has an annual capacity of 305 metric tons and essentially transforms the tails material to an inert form which can be compactly stored for future use or disposal. The cost of converting this material is about $4 per SWU, and is included in the price of Eurodif enrichment services.

The French Point of View on Laser Enrichment

Jean-Hubert Coates of Commissariat a l'Energie Atomique (CEA), stated that France is on schedule to build and operate an industrial prototype of the SILVA enrichment process by 1995. The French criteria for deploying a new technology is that deployment must be available by the end of the century, should be of modular design, must be highly selective (can accept reprocessed uranium feed), and that production cost be significantly lower than the present SWU price. Mr. Coates believes that the cost of producing SWU from SILVA will be about $60 per SWU and that the first plant module will be constructed during the years 2000 to 2005, with plant deployment during the 2005 to 2010 timeframe.

NRC Views on Regulation of Enrichment Facilities

An overview of the one-step licensing process for an enrichment plant was provided by Mr. Robert M. Bernero of the US Nuclear Regulatory Commission. He stated that the main criteria for an applicant under this process is a final design submitted up front, and an environmental impact statement completed in conjunction with the one public hearing to consider the issues. The result of this process will grant the applicant a construction/operation license. Mr. Bernero went on to discuss the Louisiana Energy Services application. He expects that the licensing of the facility will proceed on schedule, primarily because of the existing centrifuge facilities that exist in Europe and the extensive operating history and data that is available.

The First Enrichment License Application: An LES Perspective

Mr. Howard Arnold of Louisiana Energy Services (LES) described the organization of LES and the activities taken to facilitate licensing of the plant, permitting it to make its first delivery of enrichment services by 1996. Inherent design features, such as not using reprocessed uranium and producing only low-enriched material, are expected to reduce intervenor concerns during the hearing process. Much attention now, however, is being directed to gaining customer contracts to purchase enrichment services, so that LES can borrow funds for its construction financing. Once contract order books are filled, LES plans to start serious discussions with the financial community to put together a financing plan for the approximately US$800 million construction cost.

The Post-1995 Market: Who's Filling The Gap?

John Longenecker, chairman of the USCEA Enrichment Task Force, moderated a panel that addressed several questions involving the post-1995 enrichment market. The panel discussed how utilities would buy enrichment services in the future and what factors would be considered. A diverse opinion was expressed by panel members, with enrichment supplier representatives generally agreeing that enriched uranium product (EUP) will not play a major role in future utility fuel purchases. Other members of the panel suggested that EUP can offer good value and that utility purchase decisions would be governed by economics. Panel member Earl Hoellen of NUEXCO, emphasized that utilities will diversify product-form purchases because of the competitive market, and that as enrichment takes on the characteristics of a commodity, EUP will play a part in that transition.

On the matter of security of supply and price, the panel concluded that the question is the degree of risk utilities are willing to accept and at what price level that risk can be justified. With current levels of enrichment capacity, the risk may be minimal; however, suppliers noted that there

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is an uncertainty as to whether primary suppliers will continue to carry excess/uneconomic capacity. There is also a possibility that supply could decrease during the late-1990s, becoming more in balance with demand.

The panel's attention then turned to the role the Soviets may play in the market. DOE's position is that the Soviets should be a player based on free trade practices, that they should be pricing under a fair trade basis, and that there is risk associated with the uncertainty of Soviet supply because of changing governments. Other panel members pointed out that the Soviet entry into the market has made the market more competitive. The marginal cost of Soviet capacity, which comes from centrifuges installed over 20 years ago, is undoubtedly very low, and economics dictate that the lowest-cost supply will be used.

DOE's marketing of its incentive price offer and its effect on the market was also discussed. It was felt that DOE's offer at this time accelerated utilities' timing for making a decision on post-1995 purchases. However, other suppliers asserted that they are not driven by DOE actions, but by their own long-term strategies. Peter Jelinek of Urenco, believes that DOE's offer will not greatly impact the post-1995 market, since the offer is only for a short time period (1996-1998) and, therefore, would not affect what Louisiana Energy Services is offering.

The final portion of the panel discussion was devoted to the role new technologies may have on the market. It was generally agreed that advanced enrichment technologies will be used as a replacement for the current technology, but only when it is needed, has been proven technically, and is economically superior to the current technology.

Capitol Hill Roundtable: Restructuring the DOE Uranium Enrichment Enterprise

On Capital Hill, a special session took place that offered conference participants the opportunity to watch all the main players debate the issues surrounding DOE's initiative to restructure its enrichment program. The panel was composed of US Congressional committee staffers, DOE and Martin-Marietta staff, and Smith Barney and utility representatives. It was clear at the end of the session that although there is gridlock between the Senate and the House over the solution to DOE's problems, it is not caused by misunderstanding or lack of information about the problem. Most issues remaining to be resolved concern money, such as unrecovered costs versus "debt." An acceptable solution to maximize cash flow and limit the liability of the taxpayers has not been developed.

All of the participants agreed that if DOE is to be competitive in the long-term enrichment market, it must be restructured. However, not everyone agreed that DOE should be competitive, nor was there agreement on what type of restructuring is most effective, given the various groups' often incompatible goals. There does seem to be growing interest in the House to accept all liability and costs of the current gas diffusion plants, and simply attempt to license AVLIS in order to recover some money for the Treasury. Nick Timbers of Smith Barney pressed the argument that the main problem with privatizing AVLIS is that there is no way for a private company to evaluate both the technical and financial risks of deploying AVLIS. He feels the financial risks are manageable once the technical risks have been eliminated. The panel concluded without reaching a consensus.

The US AVLIS Program

An overview of DOE's AVLIS program was presented by Robert M. Feinberg of Lawrence Livermore National Laboratory. Mr. Feinberg described the major AVLIS systems that are now under construction and testing for demonstration in 1992. It appears that a three to six month delay may arise due to budget reductions and resulting schedule slippage. Should the demonstration be successful, however, AVLIS could be ready for commercial deployment with a small-sized plant of about four million SWU, operating as early as 1997 to 1999. A factory cost of about $25 to $50 per SWU is projected, which includes all capital outlays and depreciation. The maximum assay of the plant would be 5.0 % U^{235} with a tails assay of 0.1 % U^{235}. Mr. Feinberg emphasized that industry now has the means to provide U-metal feed for a four-million-SWU per year plant and estimated the cost of converting the U-metal product to UF_6 would be about $4 to $6 per SWU.

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WASHINGTON FOCUS

by Linda L. Gunter

During June, the Senate considered several key pieces of legislation relevant to the nuclear industry. The Senate approved S 210, the Comprehensive Uranium Act of 1991, and the Senate Energy & Natural Resources Committee reported out S 1220 (previously S 341), the National Energy Security Act. The committee also approved S 1138 authorizing the Department of Energy (DOE) to begin characterization of Yucca Mountain as a spent fuel repository, despite the state of Nevada's refusal to issue environmental permits. The Senate Appropriations Committee voted on the Energy & Water Development bill for FY 1992. In the House of Representatives, the Energy & Power subcommittee began a series of hearings on national energy policy preparatory to drafting an omnibus energy bill. President Bush nominated E. Gail de Planque, a past president of the American Nuclear Society, to be the fifth Nuclear Regulatory Commissioner. If confirmed, she will replace Tom Roberts whose term expired last year. The NRC has been operating with only four Commissioners. With the Senate's confirmation of Ivan Selin as NRC Chairman on June 21, the NRC will be back to full strength shortly.

Enrichment Bill Passes Senate

◇ On June 12, the Senate unanimously passed S 210 for the fifth time in six years. Senator Wendell Ford (D-KY) said "We simply cannot allow this bill to die again in the House of Representatives. We can't afford to go on with business as usual. Time is of the essence, and I'm going to be doing all I can to see that my House colleagues get this message loud and clear." This bill is also incorporated as Title X of the National Energy Security Act (S 1220) which the Senate may vote on this summer. The House has shown little interest in the Senate's enrichment bill. However, if the House does pass an omnibus energy package, the issue may be addressed again during a conference with the Senate.

Energy Policy Bill

◇ S 1220 is a proposal for crafting a national energy policy. The act contains titles supporting advanced nuclear reactor commercialization, licensing reform, and restructuring of DOE's uranium enrichment program. The act has generated controversy because of provisions which address Corporate Average Fuel Economy (CAFE) standards, and allow opening of the Arctic National Wildlife Refuge, an action environmental groups oppose. A number of committees, including the Environment and Public Works committee, have sought jurisdiction over the bill, and therefore may delay the act's consideration by the full Senate.

Senate Approves Energy & Water Appropriations Bill

◇ The Senate Appropriations Committee approved its $ 19.98 billion Energy and Water Development Appropriations bill (HR 2427). The bill includes $490 million more than the House version. The committee was more generous than the House with the nuclear programs in its jurisdiction. Nuclear energy R&D was funded at $346 million, $36 million more than the House bill, but still $52 million less than DOE's budget request. The advanced reactor R&D program received $59.5 million, $10 million more than the House bill. However, space reactor program funding was reduced by $12 million, to $44 million. The new production reactor program was funded at $483 million, $17 million less than requested and $54 million less than the House allocation.

The uranium enrichment program was allocated $1.367 billion, compared to $1.337 billion from the House. The Senate restored $30 million for funding the AVLIS (Atomic Vapor Laser Isotope Separation) program and specifically earmarked $20 million for pre-deployment activities. The report language criticizes DOE for "not providing the necessary leadership to assure that the USA benefits from the technology." The committee also said it is concerned "about the lack of

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direction and control of the AVLIS program and the apparent lack of an administration commitment to complete the technology demonstration." The report notes that the USA has a technical lead of 3-5 years over the competition and "failure to implement predeployment activities immediately will greatly increase the risk that the USA will lose the international lead position in uranium enrichment... Delay will also lead to cost growth. These effects will decrease the value of AVLIS technology in the marketplace and will substantially increase the difficulty of achieving the administration goal of privatization. Successful deployment of AVLIS may require significant private sector investment. Private sector investment is possible only if qualified firms have access to the technology and market information with sufficient lead time to work with investors to develop sound investment plans." Because of the differences in funding levels between the House and Senate versions of the bill, staff from both committees are expected to meet to resolve these differences prior to a Senate vote on its bill. A vote is now expected sometime after the July 4 recess.

Yucca Mountain Permits

◇ The Senate Energy Committee reported bill S 1138 which authorizes the federal government (Environmental Protection Agency–EPA) to issue permits the state of Nevada has withheld, so DOE may proceed with characterization of the Yucca Mountain high-level spent fuel repository site. The day after the vote, the Nevada Department of Environmental Protection issued two of the 18 environmental permits DOE has requested. But these permits are contingent upon a water quality permit which the state has not granted. EPA has testified it is not overriding state authorities, but feel it is imperative that the program move forward to determine if the site is suitable for the storage of high level nuclear waste. "It is not prudent to have nuclear waste stored at 111 sites across the country." Under a US District Court order, the state has until July 17 to respond to DOE's complaints.

S 1138 also repeals sections of the Nuclear Waste Policy Act related to the Monitored Retrievable Storage facility (MRS). To allow DOE to begin the selection process for an MRS host state, the bill uncouples the permanent repository from the MRS. Under the original bill, the government promised to begin accepting spent fuel from utilities in 1998. In order to maintain that schedule, DOE hopes to find an MRS host by 1992. The government's Nuclear Waste Negotitator, David Leroy, is seeking volunteer states. The Senate has chosen to separate the waste issue from the omnibus energy package because of its controversial nature. Energy committee staffers in the House, however, have indicated that if the House considers the issue, it will be as part of an omnibus energy package.

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INDUSTRY BRIEFS

France and South Africa To Sign NPT

As part of a new French global disarmament policy published on June 3, President Francois Mitterrand committed his country to signing the Treaty on the Nonproliferation of Nuclear Weapons (NPT). France's formal adherence to the treaty will leave China as the only recognized nuclear weapons state that has not signed the NPT. France is hoping that, following the announcement, China will also agree to sign the NPT. The French government did not announce a specific date for France's signing of the NPT, allowing China the opportunity to sign at the same time.

On June 27, South Africa announced that it will sign the NPT. Also, President F. W. De Klerk signed Parliament-passed bills repealing all legal racial segregation. However, a new constitution must be drafted and passed before these new laws can take full effect.

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ALP Conference Vote: Three Mines Policy Is Kept

The Australian Labor Party (ALP), the ruling party in Australia, voted at its national conference in late June to maintain its three mines policy. This policy permits only three mines to operate—the Olympic Dam and Ranger mines, plus Nabarlek, which completed mining in 1988. (*See* Recent Developments *on page 13 for more details.*)

Canadian-Italian Consortium To Complete Romanian Unit

Atomic Energy of Canada (AECL) and Ansaldo S.p.A., an Italian engineering firm, agreed to create a consortium that will complete Romania's Cernavoda I unit. The ultimate plan is for the Cernavoda station to have five units. AECL will supply the CANDU nuclear steam supply systems, while Ansaldo will be involved in the remainder of the plant. AECL and Ansaldo have a contract worth approximately US$360 million with Romania's nuclear agency, RENEL, for the reactor's completion. However, the contract is contingent on Canada's Export Development Corporation approving a US$240 million loan. Ansaldo would arrange financing for the balance of the contract amount.

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German Utilities Part Owners of New French Nuclear Plant

PreussenElektra, Bayernwerk, and RWE Energie AG together will purchase a 25-percent share in a joint subsidiary that will own one (or more) of EdF's planned 1,400 MWe units at the new Civaux station. This ownership is in return for Germany's allowing EdF to purchase a 15-percent interest in VEAG, the electric utility for Eastern Germany. These three German utilities had hoped to gain a share in EdF itself, but encountered strong political and labor opposition to foreign utilities sharing in EdF.

Rio-Hydro Contract Revised

On June 17, Ontaro Hydro's new chairman Marc Eliesen announced that, following negotiations with Ontario's New Democratic Party-controlled government, Ontario Hydro and Rio Algom had agreed to revise the termination date of Hydro's long-term uranium contract with Rio. Under an economic obsolescence clause, the utility could have cancelled deliveries after 1993. Deliveries now will continue through mid-1996, and the quantities will be increased. Hydro will still pay the original contract's above-market price for the 3.7 million pounds equivalent U_3O_8 of uranium to be delivered from now to mid-1993. However, the utility will pay a fee much closer to market price for an additional 5.9 million pounds above the original contract. In addition, Ontario Hydro will provide a C$250-million contribution to the Elliot Lake economy.

♦ ♦ ♦

Japan's MITI Issues Permits For Construction of 2 GE ABWRs

Japan's Ministry of International Trade & Industry (MITI) recently issued establishment permits to Tokyo Electric Power Co. that allow it to begin construction of Kashiwazaki 6 and 7. The units, designed and supplied by General Electric, will be the world's first advanced boiling water reactors.

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RAW MATERIALS

THE URANIUM INDUSTRY OF BULGARIA

For 45 years, the Bulgarian uranium industry operated behind an impenetrable veil of secrecy. As this veil is slowly lifted, the breadth and structure of the industry are becoming apparent—and so are the problems.

Bulgaria's uranium industry began in 1945 with the evaluation of several uranium mineral occurrences in the Balkan Mountains. These occurrences proved to be mineable deposits and became the foundation for a continuing program of exploration and development. Mining commenced in 1946, and all production was exported under contract to the Soviet Union in exchange for an eventual supply of fabricated nuclear fuel. In concert with most other countries of the COMECON block, Bulgaria's exploration and development program reached its zenith in the late 1960s and early 1970s. Like other COMECON countries, the contract with the Soviet Union was reduced during the 1980s and finally terminated.

The Bulgarian uranium industry now is under substantial pressure to:

- Maintain uranium production as a base of support for its 10,000 employees.
- Develop mineral deposits other than uranium as a replacement for high-cost uranium production.
- Clean up past and present production sites, most of which have significant environmental problems.

The probability of successfully completing these three tasks without outside assistance is limited. Bulgaria's almost complete dependence for four and a half decades on Soviet aid, contracts, and technology has taken its toll.

STRUCTURE

The Bulgarian uranium industry is operated and administered by Redki Metali (Rare Metals), an enterprise created in 1989 on the basis of new legislation passed by the parliament. It is the successor organization to the original state enterprise formed forty years ago.

Redki Metali operates through a number of divisions, including: conventional mining operations, in-situ leaching facilities, a prospecting division, an equipment service and repair organization, a research and development group, a housing/food division, a domestic commercial enterprise group, and an international trade group.

Similar to many mining enterprises around the world, the firm provides most of the housing for its employees. In contrast, however, Redki Metali also provides the bulk of its own food, at no cost to its employees. The employees are now represented by a union and receive a wide range of social and recreational benefits including their own ski area.

GEOLOGY AND GEOGRAPHY

Bulgaria is situated near the southeast corner of the European Continent (**Figure 1**). It covers an area of 43,100 square miles (112,000 km^2), slightly larger than the state of Ohio in the USA. It is bounded on the north by Romania, with the Danube River along most of this border. To the west is Yugoslavia; to the east, the Black Sea; and to the south are both Greece and Turkey. Bulgaria's population is nine million people, with the capital and largest city, Sofia, containing about one million citizens.

Geologically, the country is on the eastward extension of the Alpine Fold Belt, best known for its mountainous expression, the Swiss Alps. This belt is a major feature of southern Europe and is the result of compressive forces acting on different large land masses that have come together to form the continent. In the area of Bulgaria, three different tectonic plates exist. The northern third of the country is known as the Moesian Plate and is made up mainly of folded older sediments and metamorphic rocks. At the southern edge of this plate, the Balkan Mountains extend east-west across the country. The southwest portion of the nation is underlain by a thick section of old basement rocks with many faults and later volcanics known as the West Rhodope. The southeast portion of Bulgaria consists of a thick section of older sediments and volcanics known as the East Rhodope. Major fault systems exist between these plates and, to a lesser extent, inside them. The Plovdiv Basin occurs along an east-west line between the northern plate and the two southern plates. This basin is filled with younger sediments and thickens to the east, towards the Black Sea.

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Figure 1
URANIUM PRODUCTION FACILITIES AND MAJOR CITIES OF BULGARIA

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Bulgaria is located along the ancient migration path between Europe and Asia Minor and has a mining history dating from prehistoric times. Currently, it produces most of its own mineral requirements and has a broad industrial base. Major resource trade items include imports of iron ore and petroleum from the Soviet Union, and the export of manufactured products to eastern Europe. A good system of roads and railroads connects Bulgaria to both Europe and Asia. The ports of Burgas and Varna on the Black Sea provide outlets for international trade with Romania, Turkey, and the Soviet Union.

PRODUCTION CENTERS

Redki Metali maintains three uranium production centers: Bukhovo, Elesnica, and Plovdiv (**Figure 1**). The combined production capability of these centers is approximately two million pounds U_3O_8 per year. The current production rate is slightly more than one million pounds U_3O_8 per year.

Bukhovo

The Bukhovo uranium production center includes the headquarters of Redki Metali and a conventional uranium mill. It is located only 20 kilometers northeast of Sophia and has acted as milling center for a series of mines up to 100 kilometers away, including Proboinica, Gaber, and Senekos. Many of these mines are located in the Balkan Mountains on the periphery of a syenite intrusive. The uranium deposits of this region are hosted by carbonaceous Silurian schists transected by lamprophyre dikes, and occur as irregular veins or stockworks where pitchblende has been deposited in breccia zones. Mining has been largely by underground methods.

The first extraction plant at the Bukhovo site was built in 1949. It was replaced by a sorption-type plant in 1956 which operated until 1989. A new sorption plant was commissioned in 1989, but only operated on a trial basis for about five months. It was closed in 1990 for environmental reasons, including excessive dust from dry grinding. At present, the plant is officially classified as "on standby", but current efforts seem to focus on its use for processing other minerals such as molybdenum, tungsten, and vanadium.

The design capacity of the Bukhovo plant is 600 thousand metric tons (tonnes) of ore per year with an output of about one million pounds U_3O_8 per year. The plant has both an acid and an alkaline circuit, as well as a flotation section to remove sulfides (**Figure 2**). The acid side can treat 400 thousand tonnes of ore per year; the alkaline side, 200 thousand tonnes.

Mine-run ore is transported to Bukhovo by rail and hauled from the rail siding to the top of the gravity-feed mill by truck, where it is dumped through a 300-millimeter grizzly sizing grate. A conveyor moves the ore to a 5-meter diameter semi-autogenous grinding (SAG) mill. The SAG mill

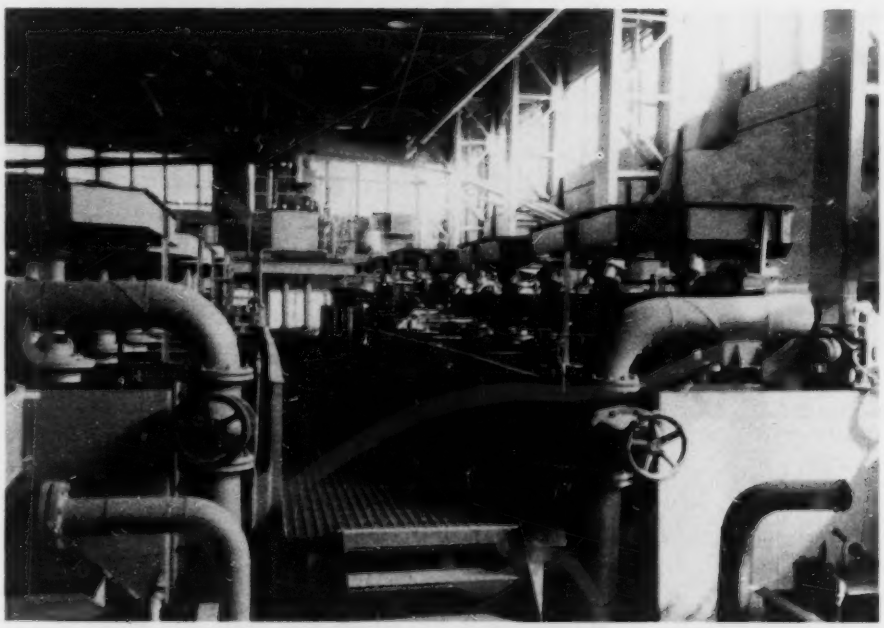

Figure 2 — The flotation section for removing sulfides at the Bukhovo uranium production center.

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discharges through a trommel, with the +20mm fraction being fed to a cone crusher, and the undersize fraction, directly to a fine ore bin.

At this point, the acid and alkaline circuits diverge to separate 42m³ ball mills, operated in closed circuit with classifiers. Acid-amenable ores are ground to 60 percent minus 200 mesh. The ball mill discharge is fed to a peripheral-drive thickener, 30 meters in diameter, where the pulp is thickened to a density of 1500 grams per liter (g/L) in preparation for leaching.

The hydrometallurgical recovery process includes the following steps: sorption, extraction, concentration, uranium precipitation, and calcining. The sorption section of the hydrometallurgical plant includes twelve 16m-high, 4m-diameter, rubber-lined, air-lift Pachucas in the acid circuit. Sulfuric acid, manganese dioxide, and ion exchange resin are mixed with the pulp. Contact time in the countercurrent system is four to six hours. The ion-exchange resin (both Hungarian "Varian" and Soviet "AMP" are used) is loaded to about 15 kilograms U per cubic meter and stripped with concentrated (120g/L) sulfuric acid in regeneration columns, which measure 2.38m in diameter and 16m in height. The resulting pregnant solution has a uranium concentration of 2.0 to 2.5 g/L. Residual loading of the resin is about 1.0 kg/m³.

The alkaline circuit operates in similar manner but with two thickeners, ten Pachucas operating at 80°C, and twice the contact time. Uranium recoveries are about 10 percent lower than in the acid circuit.

The pregnant solution is concentrated in a four-stage solvent extraction process with a 1:1 aqueous-to-organic ratio, and with 0.15 gram moles extractant in kerosene. Uranium is stripped from the organic with ammonium carbonate, precipitated and dried at 700°C, to produce U_3O_8.

On an overall basis, the plant requires 100 kWh electricity per tonne of ore and has an operations staff of 300 to 350 employees.

Elesnica

The Elesnica uranium production center is located about 120 kilometers south of Sophia near the town of Bansko, a scenic winter sports area. This production center has exploited a number of related open-pit and underground deposits, the first of which was discovered by airborne radiometry in 1954. Mining commenced in 1955 on an open pit deposit; it was exhausted in 1960, but deeper drilling identified a richer underground ore body containing about 3.1 million pounds equivalent U_3O_8. Continuing exploration located additional ore bodies, allowing uninterrupted production through the present. The production rate has been as high as one million pounds U_3O_8 per year; current production is at a rate of 390 thousand pounds per year.

Ore deposits in the Elesnica district occur in a graben environment of fluvial sandstones of Oligocene age. The sandstone series is over 1,200m thick and includes six major depositional sequences, all derived from the nearby Rila and Pirin Mountains. Each of these sequences exhibits a basal breccia overlying the fine, upper sediments of the previous layer. The ore bodies are flat-lying and irregular, and occur at several levels within the depositional sequence. Ore grades are generally less than 0.10 weight-percent (%) U and original resources of the district totalled almost 26 million pounds U_3O_8.

Uranium mining at Elesnica is currently focused on one underground mine served by a main hoisting shaft 660m in depth. This mine is interconnected with several others through an extensive network of levels and shafts. Ore production is now about 200 thousand tonnes per year, 90 percent of which is derived from underground mining.

The mine has been developed by a series of six horizontal levels at 40m spacing. Current production levels are about 360m in depth (560m above sea level). The mining method is selective room and pillar, with slushers used almost exclusively in the stoping areas. Ore is slushed into 1.0m³ rail cars that are trammed to the shaft, hoisted to the surface, scanned radiometrically, and automatically dumped to the ore or waste side of the headframe. The cut-off grade is 0.02 %o U for underground mining, 0.01 %o U for surface mining.

Water inflow to the mine equals about 1,100 gallons per minute, all of which is discharged after treatment in sedimentation ponds and ion exchange columns. This inflow has a uranium content of 3-4 parts per million (ppm), most of which is recovered in the treatment process. The ventilation capacity of the concrete-lined main shaft (5.5m in diameter) is 250,000 cubic feet per minute, but the ventilation rate is decreased in the winter because there is no means of heating the air.

The Elesnica hydrometallurgical plant operates in a similar manner to the Bukhovo plant, but has only an acid leach circuit. Following primary and secondary crushing, the ore is ground in ball mills to minus 70 mesh and transferred to Pachucas where it is leached with sulfuric acid in two stages. Ion exchange resin is added to the second stage Pachucas and regenerated with strong acid (120g/L) in 10m x 1.6m columns. Resin losses amount to 280cm³/tonne

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of ore. The ammonium uranyl tricarbonate precipitate is calcined to produce a U_3O_8 product. Acid consumption is a relatively low 30kg/tonne of ore, due to the high silica content of the ore. Elesnica also treats loaded resin trucked from Redki Metali's in-situ leaching (ISL) operations in the Plovdiv area.

Employment at Elesnica totals 1,400 workersfor the mine: 800 work underground and the remainder work on logistics and at support facilities, including the town site. An additional 300 are employed at the hydrometallurgical plant. Take home pay amounted to about 1,000 leva per man-month in April 1991, or about US$65 at then-current exchange rates. Typically, the miners work from five to eight years underground, and then on the surface until retirement at age 45. All uranium miners qualify for 42 days of vacation per year.

Plovdiv

Redki Metali operates an extensive network of in-situ leaching facilities in the Plovdiv area. These facilities include 14,000 wells in fifteen well fields, four satellite recovery units, and one resin enrichment unit. Current production from these facilities amounts to approximately 800 thousand pounds equivalent U_3O_8 per year.

Uranium ore bodies of the Plovdiv area occur in buried channels cut into fine-grained Pliocene sandstones. The productive horizon varies in thickness from 10 to 50 meters, while the ore zones range from 30 to 40 centimeters to 3 to 4 meters in thickness. Clay overlies the sandstone and serves as a confining layer to the well-field solutions. Disequilibrium is common.

ISL operations are based upon a hexagonal wellfield pattern with spacings of 20-25 meters between wells. The average well depth is 250m. Sulfuric acid with a strength of 7g/L is injected into ore horizons; the strength of the recovered solution is 3g/L. Overall acid consumption is 430kg of acid per kgU. Uranium concentrations in the recovered solutions average 10ppm and the cut-off point is 4ppm. Injection pressures are 85 pounds per square inch. Well construction techniques are similar to those in the US, with the use of PVC (polyvinyl chloride) pipe and screens, but air lifts are used instead of pumps. Energy and acid costs account for 20 and 30 percent of the total production costs, respectively.

Recovered well-field solutions are piped through collection headers to the satellite recovery facilities (**Figure 3**). These facilities use an ion exchange system and achieve loadings of about 15kgU/m^3 of resin. The loaded resin is trucked to a central enrichment facility where it is stripped under strong-acid conditions and reloaded in dilute-acid conditions to 35-40kgU/m^3. The loaded resin is trucked to Elesnica for final recovery.

Significantly, at least one of the satellite facilities of the Plovdiv ISL operation produces an NH_3AlSO_4 by-product through the use of a German resin. This aluminum recovery circuit is physically several times the size of the uranium recovery circuit.

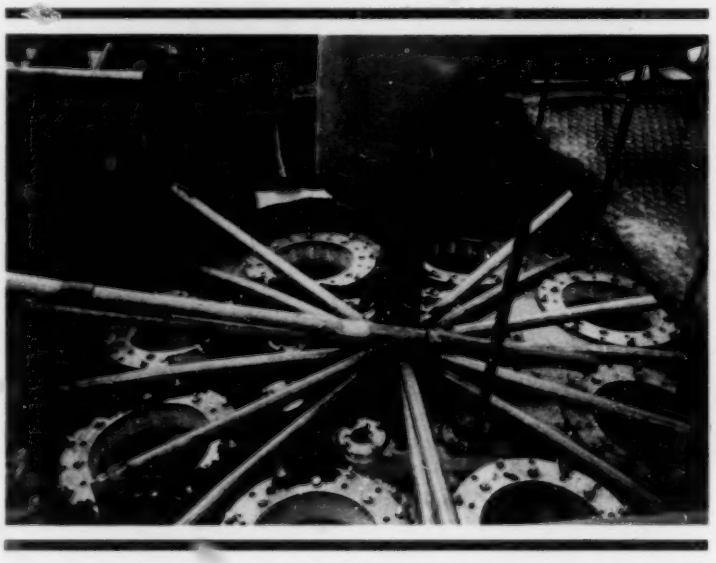

Figure 3 — An ion-exchange contactor at a satellite uranium recovery plant in the Plovdiv in-situ leaching uranium region.

Conclusion

As with most former COMECON countries, Bulgaria's uranium industry was once vibrant and productive, and operated with a high priority from the government to receive equipment and supplies as a favored industry. However, an increasingly powerful "green" movement, cancellation of the agreement to supply the Soviet Union, low prices, and high costs are likely to severely restrict, if not terminate, uranium production in Bulgaria. Now, efforts are aimed at converting production capacity from uranium to other metals, providing a basis for cautious optimism.

Thomas C. Pool

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SPEECH

THE PRESENT AND FUTURE OF NUCLEAR ENERGY AND INDUSTRY IN THE USSR

The following article is an edited version of a speech presented by Vitaly F. Konovalov, Minister of the Soviet Union's Ministry of Atomic Energy and Industry. Mr. Konovalov presented the speech on April 8, 1991 to the 24th Annual Conference of the Japan Atomic Industrial Forum in Tokyo, Japan.

Nuclear power plays an important role in Soviet energy production, even though its share of total energy production is relatively small. First of all, nuclear power makes a major contribution to the energy mix of the country's industrial regions: 33.1 percent for the North-West integrated power system, 22.7 percent for the Ukrainian system, 21.7 percent for the Central, and 16.7 percent for the Volga region. At the same time, considering the total number of nuclear power units in operation in the USSR and their combined capacity, the USSR is the third in the world after the USA and France.

As of January 1, 1991, fifteen nuclear power stations had 46 units in operation with total power of 36,560 MWe. In 1990, they produced 211.5 billion kWh of electricity, 12.5 percent of all the electricity generated in the USSR. Almost 70 percent of the Soviet Union's electricity is produced by fossil fuel plants using coal, oil, or gas; about 18 percent is produced by hydropower stations.

For the long-term, needed increases in energy production must come primarily from natural gas and nuclear power, for a number of reasons. In the European part of the USSR one can expect no significant increase in power production by coal-fired power plants. Already the average distance for fuel transportation from the East, to central regions and the Urals is about 4,000 kilometers, and fuel makes up about 40 percent of all the cargo. At the same time, the ecological burden of the coal plants (primarily air pollution) and high capital investments to reduce it to acceptable levels in the densely populated European part of the USSR make coal plants non-competitive in this region.

Due to the limited reserves remaining in the developed oil fields, the cost of oil production by the year 2000 is expected to increase by 1.5 to 1.8 times, and by 2010, by 2.0 to 2.5 times. Thus, in the coming years, the use of oil products as fuel for boilers will become economically unjustified.

However, the availability of huge natural gas reserves gives the Soviet Union the opportunity to satisfy substantial portions of its future energy needs. In the next 30 to 40 years, the power plants and boiler houses using natural gas will become a viable alternative to other fossil fuels and nuclear power plants, especially in the European part of the country.

The use of natural gas will be limited somewhat by transportation costs. The average distance for gas transportation has increased from 530 km in the 1950s, to 2,400 km at present, and that trend can be expected to continue. While natural gas is vital to the country's future energy mix, it cannot do the job alone.

Thus, from the point of view of the Soviet national economy, giving priority to the development of nuclear power in the European part of the USSR is absolutely imperative. Nuclear power is also favored on ecological grounds. The development of the nation's fuel and power production complex must pursue not only economic, but ecological requirements, and should be socially acceptable for the respective regions and the society as a whole.

The use of fossil fuel in power production is accompanied by significant releases (discharges) of contaminants in the environment, and this leads to well-known consequences, not only for the localities or regions, but for the whole world. The global influence includes the change in the thermal balance of the earth due to carbon dioxide and dust.

Nuclear power is free from several drawbacks of the fossil fuel power industry, because it does not produce aerosols or cause irreversible consumption of oxygen from the atmosphere. There are no toxic chemicals, and the uranium fission reaction requires no oxygen. The radioactive contamination of the environment and possible exposure of the population during normal operation of a nuclear power plant are much lower than sanitary and hygienic limits. Thus, the conclusion is that both from an economic and ecological point of view, it is necessary to use and develop nuclear power in the USSR, especially in the European part.

In order to understand the present state of nuclear power and its supporting infrastructure in the USSR, as well as the prospects of their development, we will briefly consider the historical aspects.

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SPEECH

By the end of the 1960s, the USSR had developed its nuclear power industry based on two types of reactors. One was a well-known pressurized water reactor, that was first used by nuclear states to power submarines (VVER). The other type was an original Soviet design of the graphite-moderated reactor (RBMK), which is similar to commercial reactors utilized by some countries for plutonium production. The selection of the second reactor concept for the development of the power industry was based on the difficulties in large scale production of heavy power-generating equipment, particularly vessels for pressurized water-type reactors.

The industrial infrastructure supporting the nuclear fuel cycle was formed in this country for defense purposes and was well developed to include mining and processing of natural uranium, production of hexafluoride and separation of uranium isotopes, production of fuel assemblies, and radio-chemical reprocessing of spent fuel.

Plans for future development of the Soviet power generation program were made public in the beginning of the 1980s and provided for:

- Rapid growth of nuclear power, so that by 2000 the combined capacity of all nuclear power plants would be 190,000 MW, and the total electricity generated by nuclear reactors would reach 1,100 million MWh, out of the total production in the country of 2,700 million MWh.
- Principal expansion of nuclear power's application for areas of industrial and district heating.
- Dynamic development of fast breeder reactors to provide nuclear power with fuel for a long period of time.
- Development of low-power nuclear facilities for remote and almost inaccessible regions, as well as for the merchant nuclear fleet.

On the basis of these plans, the country started to renew the equipment and to develop new capacities for supporting industry.

The commissioning of the Soviet Union's largest heavy-machine building plant at Volgodonsk (ATTOMMASH) was one of the key steps in the development of the necessary industrial infrastructure. This industrial enterprise was provided with all the necessary equipment for the production of highly sophisticated equipment weighing up to 500 tons.

By the middle of the 1980s, a well-developed infrastructure of the nuclear power industry was established in the country. From 1981 to 1985, seventeen power units with a total capacity of 15,800 MW were commissioned. During that period, the Soviet Union developed for commercial use the biggest power unit in the world—a 1,500 MWe RBMK. Work had also begun on the first units of district heating nuclear plants (DHNP).

Before the Chernobyl accident, the need for predominant development of nuclear power was of little doubt to the majority. But reaction to the accident has brought a considerable change in public attitudes. Society started to actively oppose further development of nuclear power and even operation of existing nuclear plants. The first result of the negative approach was drastic cuts in the plans of introducing new power production capacities. Recently, 100,000 MW of nuclear power plants were abandoned at different stages of design or construction. Soon after the earthquake in Armenia, the Armenian nuclear power station was shut down.

But it should be noted that lately, in a number of regions, one can see a tendency toward understanding the need for nuclear power, especially among people with influence on decision-making. Judging by that, good reasoning should ultimately win. As an example, the decisions of the Soviets of people's deputies in Voronezh, Kursk, Murmansk, Chelyabinsk, Semipalatinsk, Chimkent, and Eastern Kazakhstan regions favored the construction of new power units (more than 12,000 MW in total).

Naturally, the changes taking place in the country led to reductions in the power production program; current plans call for the installation of 7,000 MW of capacity during the period 1991-1995, and 12,600 MW during the next five-year period. In this case, by the year 2000, the total installed power of the nuclear plants in the country will amount to 57,000 MW, without taking into account decommissioning. For the period after 2000, the predicted increase in the rate of construction is such that, by 2010, growth in the installed power shall be 150,000-200,000 MW, with due account for decommissioning of units which have reached the end of their service lives. The final decisions are not yet taken. They will be reflected in the new national nuclear power program, with due account for the necessity of increasing installed power in the national integrated power system, decommissioning of units which exceeded their service life, and structural changes in the national economy.

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The construction of nuclear power plants in the coming ten years will be on the basis of VVER-1000 reactors having enhanced safety performances. These improvements will be, to the maximum possible extent, introduced in the nuclear plants in operation or under construction.

After 2000, the power stations under construction shall have new-generation commercial units with enhanced safety (type VVER-92, VVER-500, VPBER-600, and FBR). These will be realized by the year 2000 on the basis of previous designs and from 30 years of experience in the field of nuclear power.

Thus, two important stages may be marked in the strategy of nuclear power development that meet the requirements of acceptable risk:

- 1990-2000 may be considered a "renovation" stage with the introduction of new units with enhanced safety, and with a low rate of increase in the total power produced by nuclear. This should be a period of extensive R&D to form the scientific and design basis for future intensive development of nuclear power.
- 2000-2010 is the stage of dynamic increase of power production using the new generation of nuclear units having better economic features and enhanced safety.

Due to the fact that the first stage is characterized by an insignificant increase in the overall power generation by nuclear plants, the supporting nuclear industry of the USSR, which was developed to realize a larger power production program, has fundamental excess capacity during the first stage, that is, for the balance of this century.

So, there is a possibility to modernize a number of production enterprises in the nuclear fuel cycle and switch over to new technologies, ensuring better protection of the environment and more complete use of uranium ores. The present Soviet technology allows segregation of byproducts, such as molybdenum, rhenium, scandium, vanadium, gold, rare earths, and other valuable elements, all of which can be sold on the world market.

A progressive method of underground leaching is being widely introduced in uranium mining. This new method allows mining of the reserves of depleted uranium ores at different depths and in complicated rock conditions. Plans are to produce up to 40-50 percent of uranium by this method by 1995. Taking into account previously accumulated resources of uranium ore, the amount of the available raw material allows us to ensure supply for nuclear power plants with total power of about 100,000 MW, including the existing capacities for separation of uranium isotopes. It is worth mentioning that the separation process in the USSR is based on the use of gas centrifuges. In the USSR, there has been adopted the closed nuclear fuel cycle concept envisaging the reprocessing of spent fuel. This method ensures complex use of valuable components and getting the least amount of wastes for final disposal. A plant for reprocessing spent fuel has been put into service in our country; the second one is being constructed. The national experience has proved the economic feasibility of the chosen concept.

The second stage in nuclear power development in the USSR is tied up with a new generation of reactors and power plants which will be the logical continuation in the development of Soviet reactors designs, fully realizing the experience and using technical means of "accident management." Once the present-day safety concepts are in action, the probability of severe damage of the core is not over 10^{-6} per reactor-year.

According to Soviet experts the ideology of enhanced reactor safety incorporates the following postulates:

- Succession of the nuclear power programs and concepts ensuring safety.
- Inherent self protection of the reactors (due to inherent negative feedback in the core).
- Primary use of passive means of protection and emergency cooling, requiring no external energy or operator actions.
- Required redundancy of protection and cooling means.
- Representative justification of the sufficiency of the designed protective barriers for possible radioactive product releases in maximum design-base and hypothetical (physically possible) accidents.
- Availability of information backup and protection from operator errors.

The above principles were implemented in designing the ACT-500 district heating nuclear plants, which allowed them to be located close to the boundaries of such cities like Voronezh and Nizhny Novgorod. An IAEA mission of experts studied the design of ACT for Nizhny Novgorod and the construction activities there, and confirmed the high level of ACT-500 safety, novelty, and soundness of technical solutions.

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The next important aspect in ensuring realization of the second stage of nuclear power development is the solution to the nuclear waste management problem. The related national technical policy developed in our country is now under consideration. The policy provides for a comprehensive solution to the problem of nuclear waste from operating nuclear power plants, nuclear plants under construction, and those at the design stage. It establishes norms for the amount of nuclear waste produced, procedures for its collection, logging and accounting, transportation, temporary storage, preparation for long-term storage, and final disposal with reliable isolation of the waste from the biosphere.

The biggest amount comes from low- and medium-level wastes. And still, for these types of waste, there are no principal problems either in the process or in the economics. The technology, adopted in the USSR as well as in other countries, reduces the volume of such waste by evaporation, compression, burning different sorts of wastes, and their solidification (cementing or bitumizing) with rather low degree of leaching—not more than 10^{-3} to 10^{-4} g/cm^2 per day. We have a well-developed technology for disposing of such waste in isolated near-surface or shallow storages, which ensures isolation of radioactivity from the ecological system.

The main and the most complicated matter in practical handling of nuclear waste is handling high-level nuclear waste. The situation with such waste is different for different countries having nuclear power, and depends on the approach selected for reprocessing nuclear fuel. In the USSR, use is made of the process of vitrification for high-level waste, and work is carried out on the use of other matrices (mineral-like and man-made minerals) for inclusion of radioactive waste after extraction of uranium and plutonium out of the products of radioactive treatment. The vitrification technology has been proven in a pilot facility, and starting this year, we plan to use it continuously.

Taking into account that high-level waste management involves dealing with radionuclides having half-lives of more than tens of thousands of years, the Soviet scientists are developing methods of fractionation to separate such radionuclides from the main mass of fission products having half-lives of several tens of years, and their subsequent solidification. It is possible to use many isotopes contained in high-level waste and to develop appropriate storages for each fraction. In this case, the fractions of solidified waste with Sr-90, Cs-137, rare earth elements, and other fission products with half-lives of 30 years or more may be reliably stored. The fraction of long-lived radioactive elements requiring tens and hundreds of thousands of years for their decay may also be stored in depositories where it is possible to retrieve them, if necessary. One important variant of radioactive waste management is its transmutation. On the other hand, the development of fast breeder reactors and using them for burning actinides is surely of interest both from the point of view of waste handling and for a national electricity generation program. Such work is carried out in the Soviet Union.

The issue of decommissioning is closely related to the problem of nuclear waste. The main trend of research is in the development of a technology and a plan for the decommissioning of individual nuclear plants, and the generalization of the obtained technical and economic results. This research should give proven recommendations on how to optimize the components, construction, and subsequent use of buildings and structures in their primary role. Nuclear power plants should be operated to the full extent of the main equipment's design service life, provided appropriate measures are undertaken to enhance safety (with regular monitoring). The reactors or power plants should not be just decommissioned or shut down, but reconstructed in such a way as to permit their further use within the formed infrastructure.

Current nuclear power plants were designed without due concern about their decommissioning. This problem is now being addressed in the USSR. In order to make the problem easier and to reduce the number of units to be decommissioned at the same time, work is being carried out to extend the service life of the main equipment. For example, successful annealing of the pressurized water reactor vessel is done in the USSR.

All of the above leads to a conclusion that expansion of nuclear power in the USSR should be accompanied by the solution of a number of technical problems which are, to a great extent, similar to those in other countries. With this in view, it is exceptionally important to have worldwide cooperation. Joint efforts in working at big projects and solving common problems are already being tried around the world. One of the examples is the IAEA, which is actively promoting research and development efforts in different fields of science and technology, and solving political problems to support peaceful uses of nuclear power.

Some examples of the many programs where Soviet scientists participate are: reactor components and systems, nuclear fuel technology, spent fuel handling, man-machine interaction in nuclear power, probabilistic risk assessment, and public information. Soviet experts, together with the

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experts of Finland and Sweden, monitor the contamination of the Baltic Sea. Other directly related issues are the problems of recovery of territories contaminated as a result of previous activities, or due to accidents such as Chernobyl and Kyshtym. Even a simple exchange of information on the experience in mitigating the consequences of such accidents, in our opinion, is very fruitful. It should be noted that the International Chernobyl Center started to function under the auspices of the IAEA. Examples of international cooperation include:

- Development of joint Soviet-Italian complex dynamic programs for reactor calculations that helped to develop better understanding of the Chernobyl accident and important aspects of nuclear power safety in general.
- Cooperation with Canada on channel-type nuclear reactors.
- Cooperation with Sweden on boiling water reactors.

International cooperation has brought about a unique opportunity to make direct comparison of safety assessments both in the USSR and abroad through the introduction of a powerful computer (Syber) delivered to the USSR as a result of agreement between the Presidents of the USA and the USSR.

Due to the efforts of the Japan Atomic Industrial Forum, we have been fruitfully cooperating, for a number of years now, with the scientific and industrial organizations of Japan in the fields of power reactors, safety of nuclear power plants, bilateral seminars on problems of extending service life, reliability of fuel and structural elements for power generation reactors, and radioactive waste management. We hope to expand and make more profound our bilateral cooperation with Japan, including cooperation on commercial basis. There are good reasons for this, since international specialization and cooperation in industrial spheres are the most effective means of mastering modern technologies and solving tasks that are hard to finance by one state.

For example, this technique is used to finance the European fast breeder reactor and the ITER project. Soviet scientists may well contribute to such cooperation and collaboration, in areas such as reactors of medium power (500 and 600 MW) and district heating nuclear plants. These are but two of the areas that may be of interest to a number of countries.

An important element of our international cooperation is nuclear fuel cycle services. Up until lately, we only were offering our uranium enrichment services and fabricated fuel for nuclear power plants constructed with the help of the USSR. Recently, our country began offering natural and enriched uranium to the world market. Taking into account excess capacities of our factories, and to realize the potential of our industry's advanced processes of uranium extraction and processing, we are interested in substantial participation for a long period in this market.

For the period of 1991-95, we have the capacity to sell to the world market at least 5,000 tons of natural uranium per year. As uranium demand increases, we may increase that amount. Soviet uranium resources, according to geological surveys, are estimated at two million tons, 735 thousand tons of which may be mined at a cost less than US$60/kg of uranium.

Centrifugal separation technology for uranium isotopes allows us to offer our foreign customers enriched UF_6 under both long-term and short-term contracts. Tests have proved that it is possible to use the centrifugal process to enrich regenerated uranium, and produce a product suitable for fuel manufacturing.

At present the Soviet Union is open for commercial cooperation with other countries and international organizations in the field of peaceful uses of nuclear power. We are convinced that only mutually beneficial joint efforts in search of ways to develop international cooperation—such as industrial cooperation and joint ventures, and bilateral commercial and scientific cooperation—will favor further accumulation of knowledge in the field of nuclear physics and its practical application.

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NUEXCO

ANALYSIS AND COMMENTARY

WORLD NUCLEAR PLANT BACKLOG

As of June 1991, 59 commercial nuclear reactors were actively under construction in fifteen different countries, including former COMECON nations. In our last backlog updates of two years ago, COMECON countries were not included, and the total number of units in the backlog totalled 45. Since that time, 13 Western World units have exited the backlog and entered commercial service. NUEXCO considers a unit to enter the backlog when construction starts, and to exit the backlog when commercial operation begins. Consequently, the backlog does not include reactors that have been ordered or are planned, but are not yet under construction. It also excludes reactors that have been indefinitely deferred and all prototype fast breeder reactors. **Figure 1** shows the location of the stations under construction.

Thirteen units entered commercial operation in 1990 and thus far in 1991 (**Table 1**). The number of commercial nuclear power reactors worldwide now totals 418 units at 200 stations, operating in 25 countries, with a total net capacity of 320,363 MWe. The 59 reactors still under construction are listed by country in **Table 2**, and represent an additional 48,724 MWe (net) of future capacity. **Table 3** shows the number of units by completion percentage groups. **Table 4** lists those reactors that are presently indefinitely deferred. NUEXCO expects that most of these latter reactors will never reach commercial operation, but any that do resume construction in the future are not likely to operate until well after the year 2000.

Table 1
UNITS ENTERING COMMERCIAL OPERATION
JANUARY 1990 — JUNE 1991

Country	Unit	Commercial Operation Date
Canada	Darlington 2	10/90
France	Penly 1	5/90
France	Golfech 1	6/90
France	Cattenom 3	7/90
India	Narora 1	1/91
Japan	Kashiwazaki-Kariwa 5	4/90
Japan	Kashiwazaki-Kariwa 2	9/90
Japan	Tomari 2	4/91
Mexico	Laguna Verde 1	3/90
Soviet Union	Smolensk 3	9/90
USA	Limerick 2	1/90
USA	Comanche Peak 1	8/90
USA	Seabrook	8/90

ASIA

China

The People's Republic of China has three reactors under construction: two 900-MWe pressurized water reactors (PWR) at Daya Bay in Guangdong Province near Hong Kong, and one 288-MWe (net) PWR at Qinshan. The Qinshan unit is nearly complete and is expected to reach commercial operation in early 1992. Daya Bay 1 is approximately three-fourths complete and scheduled to begin generating power in mid-1992. China National Nuclear Corporation's (CNNC) current goals call for operating nuclear generating capacity to total 6,000 MWe by the year 2000, with an additional 6,000 MWe under construction.

India

Seven of India's reactors are included in the backlog, and represent a total of 1,540 MWe (net) under construction. All the reactors are indigenously-designed pressurized heavy water reactors (PHWR). Narora 2 is complete and should reach commercial operation by the end of 1991. Kakrapar 1, north of Bombay, is expected to go critical in late 1992, followed by Kakrapar 2 a year later. Site work has begun on Rajasthan 3 and 4 in the North, and on Kaiga 1 and 2 near the Arabian Sea. India has plans for 14 more reactors: two more PHWRs at Kaiga, two PWRs at Tarapur, two VVERs (PWR-type) at Kudankalam, and an eight-unit station at Trikkareppur in the state of Kerala on India's southwest coast.

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Indicates nuclear station with one or more units under construction

Figure
WORLD NUCLEAR STATIONS UNDER CONSTRUCTION

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Table 2
WORLD NUCLEAR POWER PLANT BACKLOG

Country	Unit	Type [1]	MWe (net)	Lead Utility or Fuel Buyer [1]	Percent Complete [2]	Estimated COD
Argentina	Atucha 2	PHWR	692	CNEA	68	1994
Brazil	Angra 2	PWR	1,245	Furnas	64	1997
	Angra 3	PWR	1,245	Furnas	39	2001
Bulgaria	Kozloduy 6	VVER	887	Energetika Association	100	1993
Canada	Darlington 1	HWR	881	Ontario Hydro	99	1991
	Darlington 3	HWR	881	Ontario Hydro	84	1992
	Darlington 4	HWR	881	Ontario Hydro	64	1993
China	Daya Bay 1	PWR	900	CNNC	70	1992
	Daya Bay 2	PWR	900	CNNC	60	1993
	Qinshan 1	PWR	288	CNNC	95	1992
Czechoslovakia (CSFR)	Mochovce 1	VVER	388	Ministry Energy & Fuels	100	1993
	Mochovce 2	VVER	388	Ministry Energy & Fuels	na [3]	1994
	Mochovce 3	VVER	388	Ministry Energy & Fuels	na	1996
	Mochovce 4	VVER	388	Ministry Energy & Fuels	na	1997
	Temelin 1	VVER	892	Ministry Energy & Fuels	75	1996
	Temelin 2	VVER	892	Ministry Energy & Fuels	40	1998
France	Cattenom 4	PWR	1,300	EdF	100	1991
	Chooz B1	PWR	1,455	EdF	75	1993
	Chooz B2	PWR	1,455	EdF	51	1994
	Golfech 2	PWR	1,310	EdF	80	1993
	Penly 2	PWR	1,310	EdF	90	1992
India	Kaiga 1	PHWR	220	NPC	18	1995
	Kaiga 2	PHWR	220	NPC	18	1996
	Kakrapar 1 (KAPP)	PHWR	220	NPC	57	1993
	Kakrapar 2 (KAPP)	PHWR	220	NPC	44	1994
	Narora 2 (NAPP)	PHWR	220	NPC	100	1991
	Rajasthan 1	PHWR	220	NPC	10	1995
	Rajasthan 2	PHWR	220	NPC	10	1996
Japan	Genkai 3	PWR	1,121	Kyushu EPC	55	1994
	Genkai 4	PWR	1,121	Kyushu EPC	18	1997
	Hamaoka 4	BWR	1,045	Chubu EPC	55	1993
	Ikata 3	PWR	846	Shikoku EPC	46	1995
	Kashiwazaki-Kariwa 3	BWR	1,045	Tokyo EPC	61	1993
	Kashiwazaki-Kariwa 4	BWR	1,045	Tokyo EPC	41	1994
	Ohi 3	PWR	1,121	Kansai EPC	92	1991
	Ohi 4	PWR	1,121	Kansai EPC	41	1993
	Onagawa 2	BWR	784	Tohoku EPC	13	1995
	Shika 1	BWR	513	Hokuriku EPC	55	1993

[1] See Abbreviations List at bottom of Table 2.
[2] Status as of 12-31-90.
[3] na: not available

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Table 2
WORLD NUCLEAR POWER PLANT BACKLOG (continued)

Country	Unit	Type [1]	MWe (net)	Lead Utility or Fuel Buyer [1]	Percent Complete [2]	Estimated COD
Mexico	Laguna Verde 2	BWR	654	CFE	62	1994
Romania	Cernavoda 1	HWR	620	Ministry Electrical Energy	63	1995
	Cernavoda 2	HWR	620	Ministry Electrical Energy	45	1996
	Cernavoda 3	HWR	620	Ministry Electrical Energy	23	1998
	Cernavoda 4	HWR	620	Ministry Electrical Energy	12	1999
	Cernavoda 5	HWR	620	Ministry Electrical Energy	8	2001
South Korea	Yonggwang 3	PWR	900	KEPCO	33	1995
	Yonggwang 4	PWR	900	KEPCO	33	1996
Soviet Union	Balakovo 4	VVER	950	MAEI	na [3]	1992
	Balakovo 5	VVER	950	MAEI	na	1995
	Balakovo 6	VVER	950	MAEI	na	1998
	Kalinin 3	VVER	950	MAEI	na	1993
	Kalinin 4	VVER	950	MAEI	na	1995
	Khmel'nitski 2	VVER	950	MAEI	na	1991
	Kostroma 1	VVER	950	MAEI	na	1994
	Kostroma 2	VVER	950	MAEI	na	1995
	Kursk 5	RBMK	925	MAEI	na	1995
	Tatar 1	VVER	950	MAEI	na	1994
United Kingdom	Sizewell B1	PWR	1,100	Nuclear Electric	50	1994
United States	Comanche Peak 2	PWR	1,150	Texas Utilities Electric Co.	86	1992
	Watts Bar 1	PWR	1,177	Tennessee Valley Authority	100	1992
TOTAL			**48,724**			

[1] See Abbreviations List at bottom of Table 2.
[2] Status as of 12-31-90.
[3] na: not available

CAPCO: Central Area Power Coordinating Group (USA)
CFE: Comision Federal de Electricidad (Mexico)
CNEA: Comision Nacional de Energia Atomica (Argentina)
CNNC: China National Nuclear Corporation (China)
EdF: Electricité de France (France)
ENUSA: Empresa Nacional del Uranio SA (Spain)
EPC: Electric Power Company (Japan)
Furnas: Furnas Centrais Electricas SA (Brazil)
KEPCO: Korea Electric Power Company (South Korea)
MAEI: Ministry of Atomic Energy and Industry (Soviet Union)
NPC: Nuclear Power Corporation (Department of Atomic Energy—India)
WPPSS: Washington Public Power Supply System (USA)

BWR: Boiling Water Reactor
HWR: Heavy Water Reactor
PHWR: Pressurized Heavy Water Reactor
PWR: Pressurized Water Reactor
RBMK: Reaktory Bolshoi Moshchnosti Kanalnye–graphite moderated water-cooled reactor
VVER: Vodo-Vodyanoi Energetichesky Reaktor–(PWR type)

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Table 3
COMPLETION PERCENTAGE OF UNITS IN WORLD BACKLOG

Percent Complete	Number of Units
90-100	9
80-89	3
70-79	3
60-69	7
50-59	6
40-49	6
30-39	3
20-29	1
10-19	7
0-9	1
Subtotal	46
Unknown	13
TOTAL	59

Japan

Ten reactors totalling 9,762 MWe of net generating capacity are in various stages of construction in Japan. Kansai Electric Power Company's Ohi 3 unit has begun loading fuel and is expected to reach commercial operation this year. The other nine units are all expected to begin operation before 1997. Japan has not started construction on any new reactors in the past year, but has 13 reactors totalling 13,696 MWe (net) in the advanced planning stage. Recent electricity demand growth estimates forecast a need for approximately 40 new reactors by the year 2010, in addition to Japan's 41 currently operating units.

South Korea

South Korea has two 900-MWe PWRs under construction—Yonggwang 3 and 4. Three more reactors are planned, including a recent order for a second 629-MWe CANDU reactor (Wolsong 2) from Atomic Energy of Canada, Limited. Electricity demand in South Korea is burgeoning, growing at a phenomenal 15 percent per year, leading Korea Electric Power Corporation's president, Ahn Byong-Wha, to recently forecast a need for as many as 18 new reactors by the year 2006.

EUROPE

Bulgaria

Bulgaria currently operates five nuclear plants and has one under construction. Kozloduy 6, an 887-MWe (net) VVER, was 100-percent complete, but is now undergoing retrofitting to meet Western safety standards and should begin commercial operation in 1992–1993. Bulgaria also had two more units under construction at Belene, but these have been indefinitely deferred, due to safety concerns and local opposition.

Czechoslovakia

The Czech and Slovak Federal Republic (CFSR) has six units under construction and plans for as many as twelve more units. Four 388-MWe (net) second-generation VVERs are being constructed at the Mochovce site, and are expected to enter commercial operation in the mid-1990s. Two 892-MWe VVERs under construction at Temelin are scheduled for completion in 1994 and 1996, although they may be delayed for modification of the instrumentation and control (I & C) systems. The Czechoslovakian utility, Ceske Energeticke Zavody (CEZ), is still evaluating bids from Western firms to retrofit the I & C system at Temelin. CEZ is also evaluating five voluminous bids from Western firms to build a new Western-design, two-unit nuclear station. A short list of bidders is scheduled to be announced by late 1991. However, due to capital constraints and safety concerns, the current government is reassessing all reactor plans.

France

Three French reactors began pre-commercial operation in 1990: Penly 1, Golfech 1, and Cattenom 3, leaving five reactors on the backlog list. Cattenom 4 is scheduled to be connected to the grid by this fall, and Penly 2 is scheduled for 1992. The other three units are planned to begin operation in 1993-1994. In 1990, Electricité de France, the national utility, placed the only order for a new reactor in Western Europe; construction has not yet begun on the 1,400 MWe Civaux 1 PWR.

Romania

Construction remains suspended on Romania's five 620-MWe (net) heavy water reactors (HWR). Despite the government's high priority on completing the

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units, construction has been frozen since 1989 pending verification and documentation of the work already completed. The suspension has allowed time for repairs and retrofits to bring the units up to Western standards. Numerous other challenges facing the Romanian government make it likely that the first of these units will not be commissioned at least until the second half of this decade.

Soviet Union

Two reactors recently entered commercial operation in the Soviet Union: Zaporozhe 5, a 950-MWe VVER in the Ukraine, began operating in late 1989, and Smolensk 3, a 925-MWe RBMK (a graphite-moderated, water-cooled reactor) near the border of Belorussia and Russia, began operating in September 1990. Due to severe local opposition, safety concerns, and economic constraints, only ten reactors remain actively under construction in the Soviet Union. In the past few years, nearly 100,000 MWe of nuclear capacity has been cut from original plans. However, the Soviet Union still has the third-largest nuclear program in the world, after the USA and France. The ten units still under construction total 9,475 MWe (net) and all are expected to be completed before the end of the decade.

United Kingdom

The only nuclear unit under construction in the UK is the 1,100-MWe Sizewell B PWR. The half-completed reactor was eight months ahead of schedule as of the end of 1990.

NORTH AMERICA

Canada

Three units at Ontario Hydro's Darlington station remain under construction. Unit 2 began commercial operation in October 1990, with Unit 1 scheduled to start up later this year. Darlington 3 and 4 should be completed by 1993, bringing the station's capacity up to 3,524 MWe. Other plans for new units in Ontario are uncertain, as the recently-elected New Democratic Party has an anti-nuclear platform and has declared that any other nuclear plant planning or construction shall be halted for at least three years, and likely will be terminated altogether. Ontario Hydro's 25-year demand/supply plan that was released in 1990 had called for ten additional reactors by 2014.

Mexico

Mexico had its first commercial nuclear plant, Laguna Verde 1, reach full power on March 17, 1990. A replicate unit to this plant is now under construction. Unit 2 is more than 60 percent complete, and is scheduled for commercial operation in 1994.

USA

Three reactors overcame a long series of obstacles and challenges and entered commercial service in 1990: Limerick 2, Comanche Peak 1, and Seabrook. Thus, the US backlog of nuclear plants actively under construction has declined to only two units: Tennessee Valley Authority's Watts Bar 1, and Texas Utilities' Comanche Peak 2. Both plants are projected to reach commercial operation by the end of 1992. This leaves seven units, in various stages of completion, categorized as indefinitely deferred (**Table 4**), including the fully-completed Shoreham unit.

SOUTH AMERICA

Argentina

Argentina has only one reactor still under construction; Atucha 2, a 692-MWe PWR, is about 68-percent complete. Design changes and financial problems have pushed back its completion date until 1994, although a recently concluded agreement with Germany for a matching-fund loan makes the future of this reactor much more secure.

Brazil

Angra 2 and 3, both 1,245-MWe PWRs, are the only two reactors under construction in Brazil. Angra 2 is about 64-percent complete and Angra 3, about 39-percent complete; however, due to capital constraints, the completion of Angra 3 is uncertain. If completed, Brazil's total nuclear generating capacity will reach 3,116 MWe (net).

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Table 4
WORLD NUCLEAR UNITS UNDER CONSTRUCTION BUT INDEFINITELY DEFERRED

Country	Unit	Type [1]	MWe (net)	Lead Utility or Fuel Buyer [1]	Percent Complete [2]
Bulgaria	Belene	VVER	887	Energetika Association	na [3]
	Belene	VVER	887	Energetika Association	na
Canada	Point Lepreau 2	HWR	900	New Brunswick EPC	0
Germany	Greifswald 5	VVER	408	Treuhandanstaldt	100
	Greifswald 6	VVER	408	Treuhandanstaldt	90
	Greifswald 7	VVER	408	Treuhandanstaldt	60
	Greifswald 8	VVER	408	Treuhandanstaldt	50
	Stendal 1	VVER	900	Treuhandanstaldt	na
	Stendal 2	VVER	900	Treuhandanstaldt	na
Philippines	PNPP 1	PWR	620	National Power Corp.	98
Poland	Zarnowiec 1	PWR	424	Atomic Energy Agency	30
Soviet Union	Bashkir 1	VVER	950	MAEI	na
	Bashkir 2	VVER	950	MAEI	na
	Khmel'nitsky 3	VVER	950	MAEI	na
	Khmel'nitsky 4	VVER	950	MAEI	na
	Rostov 1	VVER	950	MAEI	na
	Rostov 2	VVER	950	MAEI	na
	Rostov 3	VVER	950	MAEI	na
	Rostov 4	VVER	950	MAEI	na
	Rovno 4	VVER	950	MAEI	na
	Rovno 5	VVER	950	MAEI	na
	Rovno 6	VVER	950	MAEI	na
	South Ukraine 4	VVER	950	MAEI	na
	Zaporozhe 6	VVER	950	MAEI	na
Spain	Valdecaballeros 1	BWR	930	ENUSA	71
	Valdecaballeros 2	BWR	975	ENUSA	58
	Lemoniz 1	PWR	900	Iberduero	97
	Lemoniz 2	PWR	900	Iberduero	57
United States	Bellefonte 1	PWR	1,213	Tennessee Valley Authority	89
	Bellefonte 2	PWR	1,213	Tennessee Valley Authority	58
	Perry 2	BWR	1,205	CAPCO	57
	Shoreham	BWR	809	Long Island Lighting Co.	100
	Watts Bar 2	PWR	1,177	Tennessee Valley Authority	85
	WNP 1	PWR	1,250	WPPSS	65
	WNP 3	PWR	1,240	WPPSS	75

[1] See Abbreviations List at bottom of Table 2.
[2] Status as of 12-31-90.
[3] na: not available

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NUCLEAR INDUSTRY CALENDAR

1991

Sept. 4-6 ***Uranium Institute Sixteenth Annual Symposium*** (London, UK).
Contact: Uranium Institute; 44-71-225-0303; or Fax: 44-71-225-0308.

Sept. 22-25 ***International Uranium Seminar '91*** (The Don Cesar Hotel, St. Petersburg/Tampa, Florida).
Sponsored by the U.S. Council for Energy Awareness.
Contact: USCEA Conference Office; 202-293-0770; Telex: 7108249602; Fax: 202-785-4113.

Sept. 29-Oct. 2 ***American Mining Congress Mining Convention*** (Salt Lake City, Utah).
Contact: AMC Convention Office: 202-861-2800; or Fax: 202-861-7535.

Oct. 29-31 ***Uranium Hexafluoride Handling*** (William G. Pollard Auditorium, Oak Ridge, Tennessee).
Sponsored by Martin Marietta Energy Systems, Inc.
Contact: Diane Duck, MMES, 615-576-1676; or Fax: 615-576-1561.

Nov. 10-13 ***Nuclear Energy Forum*** (Westin St. Francis Hotel, San Francisco, California).
Sponsored by the U.S. Council for Energy Awareness.
Contact: USCEA Conference Office; 202-293-0770; Telex: 7108249602; Fax: 202-785-4113.

Nov. 10-15 ***American Nuclear Society Winter Meeting*** (Hilton Hotel, San Francisco, California).
Contact: ANS Meetings Department; 708-352-6611.

1992

April 12-16 ***8th Pacific Basin Conference*** (Taipei, Taiwan).
Sponsored by the Amercian Nuclear Society.
Contact: ANS Meetings Department; 708-352-6611.

Sept. 21-23 ***Second International Conference on Training for Operation & Maintenance in the Nuclear Industry***
(The Moat House International Hotel, Stratford-upon-Avon, United Kingdom).
Sponsored by the Institution of Nuclear Engineers.
Contact: INE Conference Secretary; 081-698-1500 or 081-698-4750; Fax: 018-695-6409.

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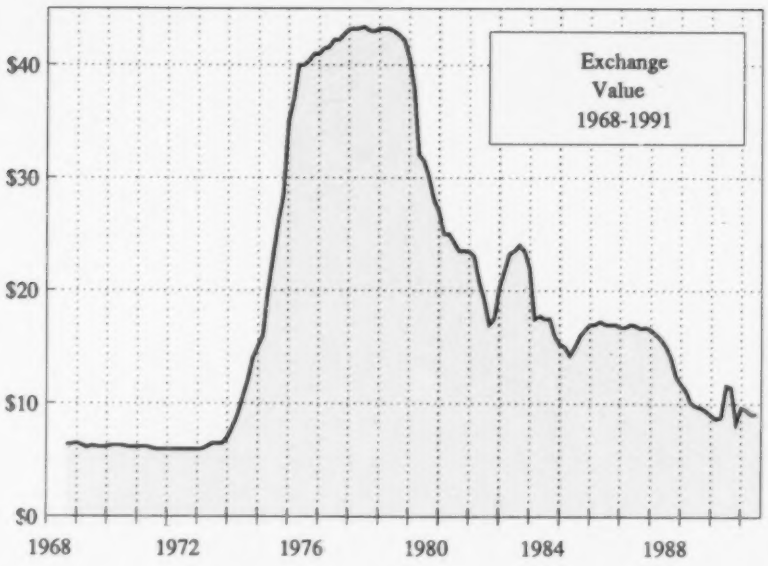
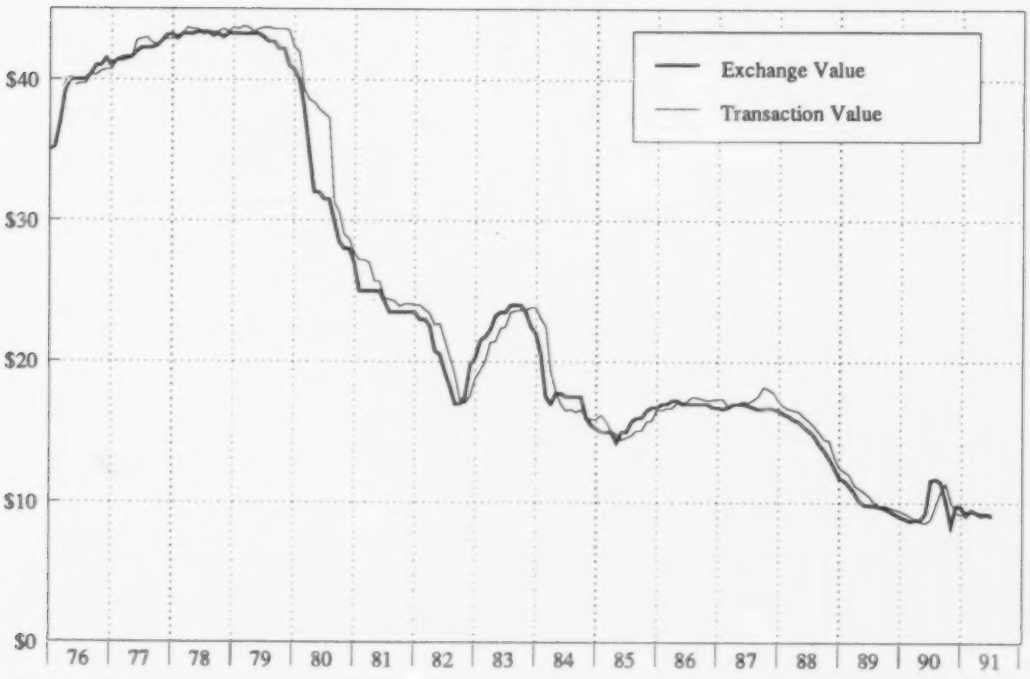
HISTORICAL MARKET DATA

NUEXCO Historical Exchange Value and Transaction Value
(in US dollars per Pound U_3O_8)





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HISTORICAL MARKET VALUES

Exchange Values

Year	Determined as of the last day of the month indicated ($US/lb U_3O_8)											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	14.25	15.00	15.00	15.75	16.00	16.00	16.50	16.75	17.00
1986	17.00	17.00	17.25	17.25	17.00	17.00	17.00	17.00	17.00	17.00	16.75	16.75
1987	16.65	16.75	17.00	17.00	17.00	16.90	16.75	16.65	16.65	16.75	16.65	16.55
1988	16.30	16.15	15.90	15.75	15.40	15.10	14.75	14.15	13.75	13.15	12.50	11.75
1989	11.60	11.20	10.70	10.10	9.85	9.80	9.80	9.70	9.60	9.40	9.20	9.00
1990	8.85	8.70	8.80	8.80	9.25	11.60	11.70	11.45	10.10	8.35	9.80	9.70
1991	9.10	9.50	9.30	9.10	9.20	**9.05**						

US Premium (Relative to the Exchange Value)

Year	Determined as of the last day of the month indicated ($US/lb U_3O_8)											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1986	—	—	—	—	—	—	—	—	—	—	0.65	0.75
1987	0.85	1.00	1.50	1.50	0.90	0.60	2.50	2.35	2.10	1.65	0.85	0.65
1988	0.70	0.50	0.15	0.25	0.60	0.00	0.00	0.00	0.00	0.00	**Discontinued**	

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HISTORICAL MARKET DATA

UF_6 Values

Year	Determined as of the last day of the month indicated ($US/kg U as UF_6)											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1985	—	—	—	40.50	42.50	42.50	44.00	44.50	44.50	46.00	46.00	47.00
1986	47.00	48.00	48.00	48.50	48.25	48.25	48.25	48.00	48.00	48.00	48.00	47.75
1987	47.75	48.00	48.00	48.00	47.75	47.75	47.50	47.00	46.75	47.00	47.00	47.00
1988	46.50	46.00	45.50	45.25	44.75	44.00	42.75	41.00	40.75	39.00	37.50	35.50
1989	34.75	34.00	33.00	30.50	30.25	30.25	30.00	29.75	29.75	28.25	27.75	26.50
1990	25.90	25.25	24.40	24.40	25.50	32.00	32.50	32.25	29.50	24.75	28.75	28.75
1991	27.50	27.75	27.50	27.25	27.60	**27.25**						

US Premium (Relative to the UF_6 Value)

Year	Determined as of the last day of the month indicated ($US/kg U as UF_6)											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1986	—	—	—	—	—	—	—	—	—	—	2.50	2.50
1987	2.50	2.50	3.50	3.00	2.25	1.75	6.50	6.00	4.25	3.10	2.25	2.00
1988	1.25	1.25	0.50	0.50	1.00	0.00	0.00	0.00	0.00	0.00	**Discontinued**	

Conversion Values

Year	Determined as of the last day of the month indicated ($US/lb U as UF_6)											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	1.50	1.50	1.60	1.60	1.60	1.60	1.60	1.60	1.60
1986	1.60	1.80	1.90	1.80	1.80	1.80	1.80	1.90	1.90	1.90	1.80	1.80
1987	1.80	1.80	1.80	1.80	1.80	1.80	1.90	1.90	1.90	1.90	1.90	1.90
1988	1.90	1.80	1.80	1.80	1.80	1.80	1.85	1.95	1.95	1.95	1.95	1.95
1989	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.90	1.90	1.80	1.75	1.65
1990	1.50	1.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45
1991	1.45	1.45	1.45	1.45	1.50	**1.50**						

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Transaction Values

Year	Determined as of the last day of the month indicated ($US/lb U_3O_8)											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	14.90	14.45	14.60	14.75	15.10	15.10	15.75	15.80	16.55
1986	16.55	16.70	16.70	17.10	17.15	17.20	17.50	17.45	17.35	17.25	17.30	17.35
1987	17.35	16.90	16.95	17.00	17.20	17.10	17.30	17.55	18.20	18.05	17.80	17.20
1988	16.85	16.65	16.55	16.45	16.10	15.80	15.45	15.00	14.50	14.40	13.30	12.50
1989	12.25	12.00	11.25	11.00	10.75	10.45	9.95	9.80	9.80	9.65	9.55	9.40
1990	9.25	9.05	8.75	8.65	8.55	8.80	9.75	10.80	11.40	10.10	9.30	9.15
1991	9.40	9.45	9.35	9.30	9.30	**9.20**						

SWU Values

Year	Determined as of the last day of the month indicated ($US per SWU)											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1986	80	80	80	80	75	78	78	78	78	78	80	80
1987	80	80	77	77	75	73	75	75	73	69	73	73
1988	73	73	70	68	68	68	68	65	65	65	65	65
1989	65	67	67	67	66	66	66	65	63	59	57	54
1990	54	50	50	50	50	50	50	50	50	51	51	51
1991	51	50	52	52	54	**59**						

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HISTORICAL MARKET DATA

Loan Rates

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	Determined as of the last day of the month indicated (Percent per Annum)											
1968	—	—	—	—	—	—	—	4.00	4.00	4.00	4.00	4.00
1969	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	6.00	6.00	6.00	6.00
1970	6.00	6.20	6.40	6.50	6.50	6.50	6.50	5.00	6.50	6.00	5.50	5.50
1971	5.00	4.75	4.75	4.75	5.00	5.25	5.25	5.25	5.25	5.25	4.50	4.50
1972	4.00	4.00	4.00	4.50	4.50	4.50	5.00	5.00	5.00	5.00	5.00	5.00
1973	5.50	5.50	5.75	5.75	6.00	6.25	7.00	7.00	7.00	7.00	7.50	8.00
1974	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
1975	8.00	7.00	7.00	7.00	7.00	6.50	6.50	6.50	6.50	6.50	6.50	6.50
1976	6.50	6.50	6.50	6.50	*	*	*	*	*	*	*	*
1977	*	*	*	*	6.50	6.50	6.50	6.75	7.25	7.25	7.25	7.25
1978	7.25	7.00	7.00	7.00	7.00	7.50	7.75	7.75	7.75	7.00	7.00	7.00
1979	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
1980	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
1981	7.00	7.00	7.00	7.00	7.00	5.50	5.50	5.50	5.50	6.00	6.00	6.00
1982	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
1983	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
1984	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
1985	6.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1986	5.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
1987	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	3.50	3.50
1988	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
1989	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
1990	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
1991	3.50	3.50	3.50	3.50	3.50	**3.50**						

* Float with Prime Rate

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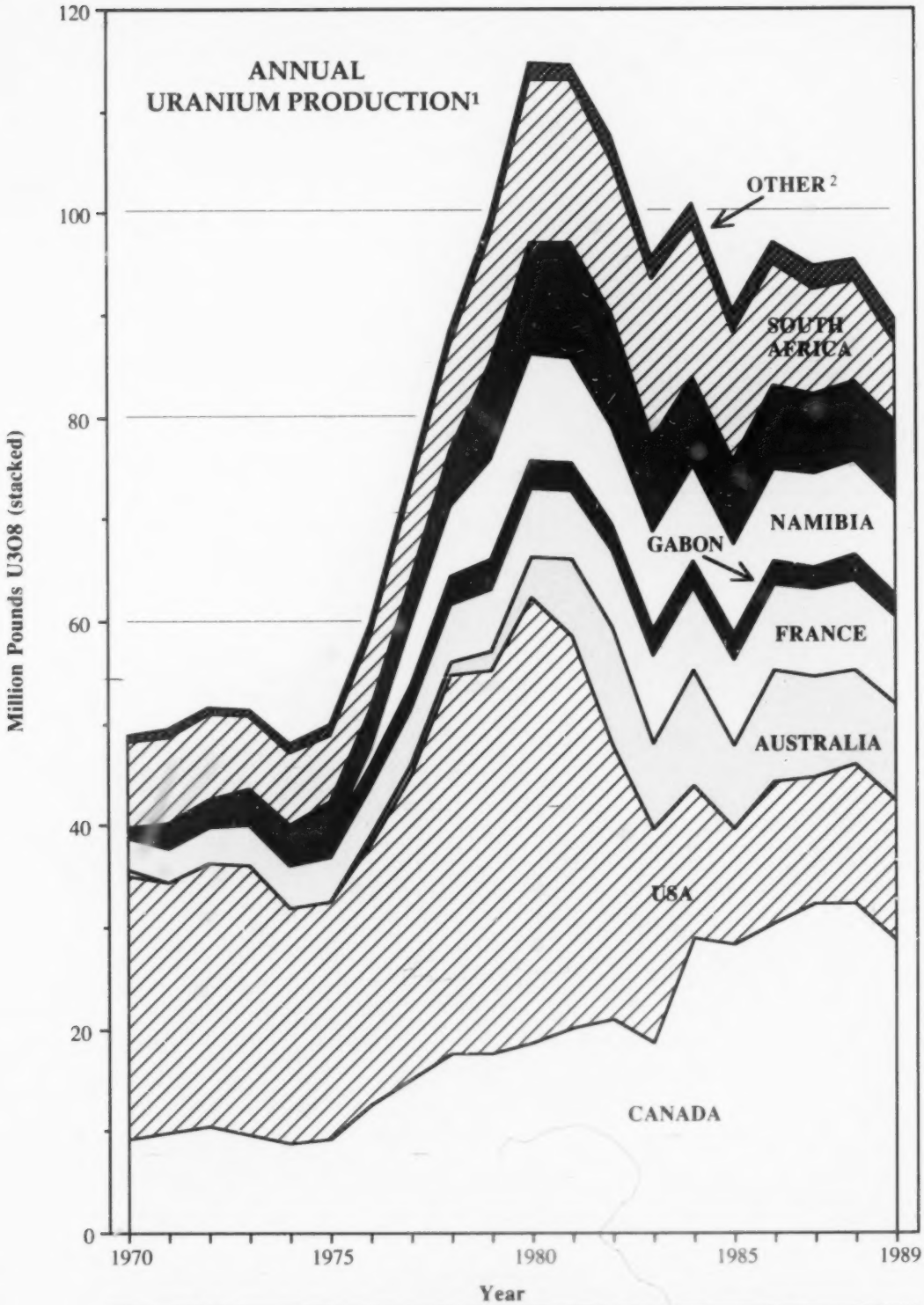

[1] Estimated world production in 1989 totalled 89.6 million pounds (Australia—9.5; Canada—28.7; France—8.5; Gabon—2.2; Namibia—9.2; Niger—7.7; South Africa—7.7; USA—13.7; Others[2]—2.3).

[2] **Other** includes: Argentina, Belgium, Brazil, India, Pakistan, Portugal, Spain, (West) Germany, and Yugoslavia

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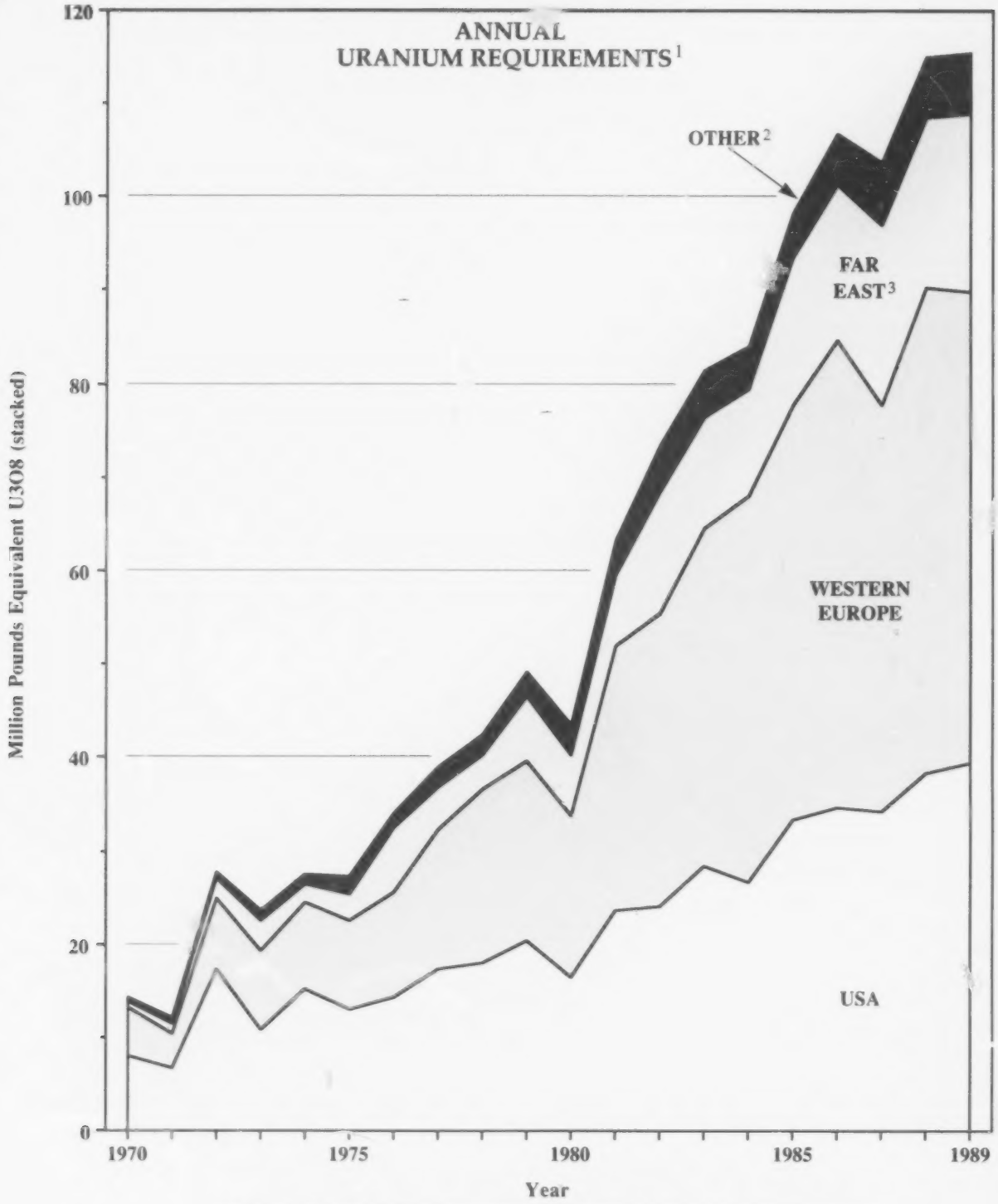
HISTORICAL MARKET DATA



[1] Calculated by NUEXCO based on actual completion dates and operating performance, and NUEXCO's estimate of enriching tails assays.

[2] **Other** include: Argentina, Brazil, Canada, India, Mexico, Pakistan and South Africa.

[3] Does not include Peoples Republic of China.

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Australia

Year	Period [1]	Consumer Price Index [2] (1980/1981 = 100)	Price Index of Materials Used in Manufacturing Industry — All Groups [3] (1984/1985 = 100)	Average Weekly Ordinary Time Earnings — Adult Males — Australia [4] (Australian dollars)	Award Rates of Pay Indexes Australia - Adult Males In Mining Wage Earners, Weekly Rates [5] (June 1985=100)
1980	Avg.	95.8	83.1	—	140.8 [6]
1981	Avg.	105.0	85.9	—	154.1 [6]
1982	Avg.	116.7	89.0	—	174.9 [6]
1983	Avg.	128.5	96.9	—	181.9 [6]
1984	Avg.	133.6	98.0	—	194.4 [6]
1985	Avg.	142.6	107.3	—	103.7
1986	Avg.	155.5	101.5	—	106.1
1987	Avg.	168.7	108.9	465.88	112.3
1988	Avg.	180.9	111.8	496.90	115.2
1989	Avg.	194.6	117.0	534.65	126.0
1990	Avg.	208.7	123.4	571.43	129.6
Jan	1990	—	119.2	—	128.3
Feb	1990	—	120.8	555.80	128.3
Mar	1990	204.1	121.5	—	128.7
Apr	1990	—	119.9	—	129.0
May	1990	—	118.9	566.60	129.2
June	1990	207.4	116.6	—	129.8 R
July	1990	—	116.4	—	129.9
Aug	1990	—	122.4	574.10	130.1
Sept	1990	208.9	128.2	—	130.3 R
Oct	1990	—	134.1	—	130.[illegible]
Nov	1990	—	133.7	589.20	130.4
Dec	1990	214.5	128.8	—	130.6 R
Jan	1991	[illegible]	12[illegible]	—	130.6 R
Feb	1991	—	121.5	—	130.5 R
Mar	1991	214.1	119.1	—	130.6 R
Apr	1991	—	—	—	130.7

P = Preliminary **R** = Revised since last month

[1] Monthly data for the period 1967 to 1986 appears in Report 233 (January 1988).
[2] Weighted average of six State capital cities (1975 to 1980), and eight capital cities from 1981 (Base: Financial year July 1980 to June 1981 = 100.0). Figures shown at end of quarter represent quarterly average.
[3] Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0).
[4] Australian Bureau of Statistics, Canberra: "Award Rates of Pay Indexes, Australia" (Catalogue No. 6312.0). Figures for the latest fourteen months shown are subject to revision.
[5] Australian Bureau of Statistics, Canberra: "Average Weekly Earnings, States & Australia" (Catalogue No. 6302.0).
[6] Base: June 1976 = 100.

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GOVERNMENT STATISTICS

Canada

		Industrial Products Price Index: All Commodities [1] (1986 = 100) [2]	Consumer Price Index: All Items (1986 = 100) [3]	Wage-earner Data: Average Hourly Earnings (C$) [4]				
				Uranium Mines (SIC 057)	Metal Mines (SIC 051-059)	Mines, Quarries and Oil Wells (SIC 051-099)	Metal Rolling, Casting and Extruding (SIC 298)	Chemicals and Chemical Products Industries (SIC 372-379)
1980	Avg.	75.7	67.1	–.–	–.–	–.–	–.–	–.–
1981	Avg.	83.4	75.5	–.–	–.–	–.–	–.–	–.–
1982	Avg.	89.0	83.7	–.–	–.–	–.–	–.–	–.–
1983	Avg.	92.1	88.5	17.22	–.–	14.18	10.67	11.10
1984	Avg.	96.3	92.3	17.89	–.–	14.97	11.11	11.68
1985	Avg.	99.0	96.0	18.53	16.48	15.56	11.85	12.12
1986	Avg.	100.0	100.0	19.38	16.70	15.76	12.28	12.58
1987	Avg.	102.4	104.4	20.12	17.15	16.11	12.58	13.20
1988	Avg.	106.9	108.6	20.91	18.51	16.95	13.17	13.77
1989	Avg.	109.4	114.0	21.97	20.02	18.41	13.71	14.16
1990	Avg.	109.8	119.4	22.90	20.93	19.12	14.62	15.28
Jan	1990	108.7	116.9	21.88	20.39	19.03	13.99	14.78
Feb	1990	109.5	117.6	22.51	20.63	19.14	14.49	15.03
Mar	1990	109.3	118.0	22.52	20.75	19.17	14.99	15.07
Apr	1990	109.1	118.1	23.17	21.20	19.46	14.83	14.93
May	1990	109.6	118.7	23.28	20.55	19.01	14.71	15.06
June	1990	109.4	119.2	21.85	20.63	18.96	14.69	15.05
July	1990	109.1	119.8	20.92	20.18	18.66	14.34	15.20
Aug	1990	109.3	119.8	23.88	20.51	18.59	14.50	15.33
Sept	1990	110.2	120.2	24.41	21.19	18.94	14.48	15.63
Oct	1990	110.6	121.2	23.11	21.39	19.12	14.78	15.59
Nov	1990	110.9	121.9	23.38	21.83	19.48	14.93	15.73
Dec	1990	110.9	121.8	23.90	21.89	19.88	14.7	16.01
Jan	1991	111.1R	125.0	23.79	21.79	19.78	14.66	15.89
Feb	1991	110.5R	125.0	25.23	22.45	20.13	14.63	16.10
Mar	1991	109.8R	125.5	24.19R	22.22R	20.27R	15.21R	16.47R
Apr	1991	109.2R	125.5	24.79P	22.52P	20.29P	14.59P	16.39P
May	1991	108.9	126.1	–.–	–.–	–.–	–.–	–.–

P = Preliminary R = Revised since last month

[1] Statistics Canada, Prices Division, Ottawa: "Industry Price Indexes" (Catalogue 62-011). Indexes for the most recent six months shown are subject to revision. This category was formerly known as "Manufacturing." Monthly data for the period 1967 to 1986 is found in Report 233.

[2] New Base Year of 1986 as of Report 266. Previous Base Year was 1981. All figures in column recalculated by 0.791 multiplier.

[3] New Base Year of 1986 as of Report 264. Previous Base Year was 1981. All figures in column recalculated by 0.755 multiplier.

[4] Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa: "Employment, Earnings and Hours." Monthly data for the period 1983 to 1986 is found in Report 233.

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South Africa

		Average Declared Working Costs per Metric Ton of Gold Ore Milled [1] (Rand)	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled [2] (March 1982 = 100)	Consumer Price Index [3] (1985 = 100)	Production Price Index All Groups [4] (1985 = 100)	Total Employment in Mining and Quarrying [5]	Total Salaries and Wages in Mining and Quarrying [5] (1,000 Rand)
							Annual Total [6]
1980	Avg.	35.53	—	51.9	55.2	709,042	2,237,689
1981	Avg.	41.89	—	59.8	62.7	722,918	2,756,928
1982	Avg.	47.25	104.2	68.6	71.4	702,041	3,181,584
1983	Avg.	51.88	115.0	77.1	79.0	700,901	3,563,282
1984	Avg.	58.95	130.3	86.0	85.6	711,511	4,134,390
1985	Avg.	68.76	151.6	100.0	100.0	724,587	4,778,612
1986	Avg.	80.22	177.9	118.6	119.5	756,637	5,767,950
1987	Avg.	95.01	223.1	137.7	136.2	751,864	6,911,395
1988	Avg.	106.69	241.1	155.4	154.1	705,355	7,774,054
1989	Avg.	116.65	273.0	178.2	177.5	700,360	8,833,934
1990	Avg.	129.37	305.3	203.8	199.4	677,742	10,193,209
							Monthly Total
Jan	1990	—	—	192.0	188.8	688,837	801,616
Feb	1990	—	—	193.3	190.3	674,026	767,274
Mar	1990	126.74	296.3	196.4	190.9	704,660	780,614
Apr	1990	—	—	198.3	194.1	696,107	810,474
May	1990	—	—	200.4	196.3	613,527	719,191
June	1990	128.25	299.87	201.8	197.0	676,621	841,165
July	1990	—	—	203.2	197.2	697,242	913,177
Aug	1990	—	—	206.5	199.8	686,385	902,392
Sept	1990	129.46	312.55	209.7	203.2	689,317	922,454
Oct	1990	—	—	211.1	206.1	676,833	882,603
Nov	1990	—	—	215.6	214.9	669,198	909,418
Dec	1990	133.02	312.37	217.1	214.7	660,151	942,331
Jan	1991	—	—	219.5	218.0	648,944	935,839
Feb	1991	—	—	222.2	219.3	650,948	893,373
Mar	1991	137.66	323.82	224.1	218.5	—	—
Apr	1991	—	—	227.3	220.9	—	—
May	1991	—	—	230.8	—	—	—

P = Preliminary R = Revised since last month

[1] Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly. Historical Data by month appears in Report 236.

[2] Page 16 of Report 178 contains description and calculation of index, and page 24 of Report 178 lists figures for 1982.

[3] Central Statistical Service, Pretoria: All income groups-weighted average. Historical Data by month appears in Report 236.

[4] Central Statistical Service, Pretoria: All commodities for consumption in South Africa.

[5] Central Statistical Service, Pretoria: Historical Data by month appears in Report 236.

[6] Annual total is shown, rather than monthly average, for indicated year.

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GOVERNMENT STATISTICS

United States

		Producer Price Index [1]		Consumer Price Index [2]	GNP Implicit Price Deflator [3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$) [4]			
		Industrial Commodities (1982 = 100)	All Commodities (1982 = 100)	(1982-1984 = 100)	(1982 = 100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1980	Avg.	88.0	89.8	82.4	85.7	10.26	10.63	8.30	6.94
1981	Avg.	97.4	98.0	90.9	94.0	11.55	11.98	9.12	7.62
1982	Avg.	100.0	100.0	96.5	100.0	12.31	12.93	9.96	8.21
1983	Avg.	101.1	101.3	99.6	103.9	12.58	13.43	10.58	8.67
1984	Avg.	103.3	103.7	103.9	107.7	13.05	13.43	11.07	9.04
1985	Avg.	103.7	103.2	107.6	110.9	13.38	13.74	11.56	9.46
1986	Avg.	100.0	100.2	109.6	113.9	12.46	13.48	11.98	9.65
1987	Avg.	102.6	102.8	113.6	117.7	12.52	12.98	12.37	9.88
1988	Avg.	106.3	106.9	118.3	121.3	13.24	13.26	12.71	9.79
1989	Avg.	111.6	112.2	124.0	126.3	13.59	13.72	13.09	10.05
1990	Avg.	115.8	116.3	130.7	131.5	14.10	14.36	13.54	10.37
Jan	1990	114.1	114.9	127.4	—	13.69	13.95	13.34	10.13
Feb	1990	113.6	114.4	128.0	—	13.70	13.99	13.27	10.16
Mar	1990	113.2	114.2	128.7	129.5	13.80	14.04	13.34	10.17
Apr	1990	113.2	114.1	128.9	—	13.92	14.30	13.53	10.17
May	1990	113.5	114.6	129.2	—	13.96	14.16	13.46	10.22
June	1990	113.2	114.3	129.9	131.0	14.00	14.31	13.51	10.27
July	1990	113.4	114.5	130.4	—	14.29	14.49	13.58	10.34
Aug	1990	115.9	116.5	131.6	—	14.27	14.60	13.57	10.33
Sept	1990	118.4	118.4	132.7	132.2	14.41	14.48	13.62	10.42
Oct	1990	121.4	120.8	133.5	—	14.43	14.58	13.72	10.47
Nov	1990	120.7	120.1	133.8	—	14.34	14.73	13.73	10.53
Dec	1990	119.0	118.7	133.8	133.1	14.39	14.69	13.75	10.57
Jan	1991	119.3R	119.0R	134.6	—	14.73	14.63	13.85	10.60
Feb	1991	117.2	117.2	134.8	—	14.80	14.55	13.81	10.59
Mar	1991	115.6	116.1	135.0	134.8R	14.93R	14.55R	13.85R	10.55R
Apr	1991	115.5	116.0	135.2	—	14.91P	14.62P	13.97	10.63R
May	1991	116.1	116.5	135.6	—	– · –	– · –	14.03P	10.68P

P = Preliminary **R** = Revised since last month

[1] US Bureau of Labor Statistics, Washington, DC: "Producer Prices and Price Indexes," (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents. Historical data is presented in Report 233.

[2] US Bureau of Labor Statistics, Washington, DC: Consumer Price Index for All Urban Consumers, US City Average, All Items. Historical data is presented in Report 233.

[3] US Department of Commerce, Washington, DC: Bureau of Economic Analysis, National Income and Wealth Division: "Survey of Current Business." The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted. Historical data is presented in Report 233.

[4] US Bureau of Labor Statistics, Washington, DC: "Employment and Earnings." All data based on 1972 revision of SIC Manual. Historical data is presented in Report 233.

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Volume and Price of Uranium Deliveries To The European Community [1]

— Compiled from data published by the Euratom Supply Agency —

Year	Volume of Deliveries to the EC [2] (MTU)	Percentage of Deliveries Made Under Spot Contracts	Medium or Long-Term Contracts [3] Average Price		Spot Contracts [3] Average Price	
			in ECU per pound U_3O_8	in US Dollars per pound U_3O_8	in ECU per pound U_3O_8	in US Dollars per pound U_3O_8
1977	n/a	n/a	n/a	n/a	n/a	$41.00
1978	n/a	n/a	n/a	n/a	n/a	$43.00
1979	10,000	n/a	n/a	n/a	n/a	$44.50
1980	8,600	n/a	n/a	$36.00	n/a	$35.00
1981	13,000	less than 10	n/a	$33.25	n/a	$28.00
1982	12,500	less than 10	ECU 32.25	$32.00	ECU 24.25	$24.00
1983	13,500	less than 10	ECU 34.75	$31.00	ECU 26.00	$23.25
1984	11,000	less than 10	ECU 37.75	$29.75	ECU 24.50	$19.25
1985	11,000	11.5	ECU 38.00	$29.00	ECU 19.50	$15.00
1986	12,000	9.5	ECU 31.50	$31.00	ECU 18.00	$17.75
1987	14,000	17.0	ECU 28.25	$32.50	ECU 15.00	$17.25
1988	12,500	4.5	ECU 26.92	$31.82	ECU 13.65	$16.13
1989	13,500	11.5	ECU 26.63	$29.35	ECU 11.04	$12.19

P = Preliminary **R** = Revised since last month

[1] The twelve European Community member nations are Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, and the United Kingdom; prior to January 1986, Spain and Portugal were not members of the EEC.

[2] The only deliveries taken into account are those made to final users, namely the electric utilities or their procurement organizations; deliveries to middlemen or fuel cycle companies are not included. The sales between utilities in the Community are also excluded. The quantities covered are those which were entered into accounting records during the year stated.

[3] For deliveries made under medium or long-term contracts (i.e., for which the time between the date of signature and the date of the last delivery exceeds one year) the prices were expressed in seven different currencies. In order to calculate an average price, these prices have been converted into European Currency Units (ECU) and US dollars. The average prices were weighted by quantity and converted on the basis of the average annual exchange rate of the different currencies against the ECU and US dollar. Exchange rates are published by European Communities Statistical Office and the International Monetary Fund.

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GOVERNMENT STATISTICS

US Uranium Marketing Activities Statistics

— Compiled from data published by the US Energy Information Administration [1] —

Year	Total Production (million pounds U_3O_8)	Deliveries to Domestic Utilities From US Suppliers [2] (million pounds U_3O_8)	Average Price of Delivered Uranium [2] ($/lb. U_3O_8)	Quantity of Uranium Imported [3] (million pounds U_3O_8)	Average Price of Imported Uranium ($/lb. U_3O_8)	Quantity of Uranium Exported (million pounds U_3O_8)
1976	25.5	27.6	$16.10	3.6	n/a	1.2
1977	29.9	27.8	$19.75	5.6	n/a	4.0
1978	37.0	31.6	$21.60	5.2	n/a	6.8
1979	37.5	33.0	$23.85	3.0	n/a	6.2
1980	43.7	35.0	$28.15	3.6	$43.10	5.8
1981	38.5	32.6	$34.65	6.6	$32.90	4.4
1982	26.9	23.5	$38.37	17.1	$25.19	6.2
1983	21.2	24.2	$38.21	8.2	$26.16	3.3
1984	14.9	22.5	$32.65	12.5	$21.86	2.2
1985	11.3	21.7	$31.43	11.7	$20.08	5.3
1986	13.5	18.9	$30.01	13.5	$20.07	1.6
1987	13.0	20.8	$27.37	15.1	$19.14	1.0
1988	13.1	17.6	$26.15	15.8	$19.03	3.3
1989	13.8	18.4	$19.56	13.1	$16.75	2.1

P = Preliminary **R** = Revised since last month

[1] Sources: 1976-1983: US Department of Energy/Energy Information Administration, *Survey of United States Marketing Activity.*
1984-1989: Energy Information Administration, *Uranium Industry Annual.*

[2] Data for 1976-1981 includes both domestic utilities and agents.

[3] Includes imports by domestic utilities and domestic suppliers.

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